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BRITISH ENCYCLOPEDIA,

OR

DICTIONARY

OF

ARTS AND SCIENCES;

COMPRISING

AN ACCURATE AND POPULAR VIEW

OF THE PRESENT

IMPROVED STATE OF HUMAN KNOWLEDGE.

BY WILLIAM NICHOLSON,

Author and Proprietor of the Philosophical Journal, and various other Chemical, Philosophical, and Mathematical Works.

ILLUSTRATED WITH

UPWARDS OF 150 ELEGANT ENGRAVINGS,

BY

MESSRS. LOWRY AND SCOTT.

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LIST OF PLATES

IN

VOL. IV.

The Binder is requested to place the Plates in the following order, taking care to make all the Plates face an even Page, unless otherwise directed.

that motive, and the support of the revenue produced by farming of the canals, do not allow the smallest despoliation to pass unpunished. We are assured, by the best authorities, that the whole of the pasture lands in the Milanese exhibit uncommon fertility; and that the canals are so very extensive, and the branches from them so numerous, that few need complain of a want of water for irrigation. These works are known to be of no modern date; some have existed for centuries, chiefly appertaining to monasteries; their waters being let out by measure to fertilize their adjacent lands. The great canal, known by the designation of Vecchiabbia, was in a flourishing state early in the eleventh century, beyond which we do not know what might have been its age. In 1220, the great canal of Adda, which waters the plains of Lodi, was finished; in 1305, the canal of Treveglio, which communicated with four others of very ancient workmanship, was completed; and in 1460, the canal of Martesano, extending thirty-two English miles: in this aqueduct, besides the main branch, of thirty-five feet in width, there were made nineteen scaricatori, or lesser canals, which served, when the waters rose very high, to draw off the surplus, so as to prevent injury to the main line, and to prevent inundation along its course: when the latter returned to a more tranquil state, the scaricatori, which were not so deep as the main line, served to supply it with what remained of their contents.

It is worthy our notice, that although the Italian aqueducts have, to our certain knowledge, been duly supported for upwards of eight centuries, by a race of people far beneath us in the more noble sciences, in wealth, in population, and in many other circumstances in which we pride ourselves; yet that Britain cannot boast of one aqueduct, made exclusively with the important view to improve her agriculture; though it would be as easy to shew a thousand situations where such canals would double the value of the lands adjoining, as it would be to prove that such value would be doubled.

It is, indeed, only in a few counties, that irrigation is carried on to any extent; though we may in various places see partial adoptions of this most beneficial practice: yet we daily observe situations naturally offering this advantage, without the smallest attempt being made to retain streams which, from elevated situations, glide with some velocity through deep vallies, whose very borders, perhaps, are verdant, but whose more retired parts would be doubled or trebled in value, by the influence of that element, which is allowed to pass by unheeded, to be lost in some marsh, or eventually in the ocean! It is true, that, in some parts, irrigation is not understood; and, that it is not always practicable to obtain proper assistance; whence many, who would willingly water their meadows, are prevented from taking advantage of streams capable of effecting the intention. For the benefit of such persons, in particular, as well as of our readers in general, we shall endeavour to simplify, even this simple process, in such a manner as may prove perfectly intelligible; and, by shewing with what ease irrigation may be carried on, induce a portion of our landholders to attempt, even without professional aid, or the tuition of experienced persons, that retention and gradual distribution of waters whose sources are sufficiently elevated, which may favour such a slight and temporary inundation, as may give vigour and freshness both to the soil and to its produce.

We shall divide this subject into two distinct heads, *viz.* simple, and compound irrigation; observing that the former may be practical in various modes separately, as will be shewn, and that they may be blended so as to come under the second term. We shall also, by way of preparation, give the reader an insight into some modes of cutting off, or of supplying water, from sources of different heights, and under different circumstances: by this means, with a moderate portion of judgment, the novice in this art may speedily acquire sufficient of the principles to answer his own purposes, at least, if not to form a correct opinion of most of the cases which may come under his observation.

The greatest difficulty we generally experience, is from the water lieing below the level of the lands over which it is to be conducted. In many instances, the springs whence streams are fed, lie very deep; and, though copious, for want of a sufficient inclination of their beds, move very slowly. In other parts, jealousy of improvement, personal enmity, the owner being a minor, or insane, and the property in the hands of trustees, or the estate being in Chancery, mortgaged, &c. perhaps debars the possibility of taking advantage of some peculiarly favourable fall, from which the water might be conducted with perfect facility and effect, over inclined planes, which, by their

sterility, seem to reproach the owner with neglect!

In treating this subject, we must suppose the speculator to be a free agent, not shackled by such an unhappy neighbourhood; and content ourselves with cautioning him not to injure the property of others, such as mills, bleaching grounds below the lands, &c. &c., by drawing off that water on which their very existence depends: a want of attention to this particular, has ruined many a deserving and enterprising individual, and converted a blessing into a serious mischief!

Where the stream is rapid, the bed has usually a very marked declivity, such as admits of throwing the water over the lands, and of withdrawing them when they have flowed, in every part, to a sufficient height. The first step towards this, is to hold it up by means of a dam or weir, laid across the stream, (if its breadth admit, and that it be not navigable), so that, in the first place, the level may be raised as circumstances may admit. In this, it will be necessary to guard against injury to the property of other persons, above the dam; for the raising a head of water, by means of a dam, might subject lands, which before were perfectly dry, to be inundated; and, even though such should actually prove beneficial thereto, the owners might recover in a court of law, under various pleas of damage.

The water should, if practicable, be raised to one foot, at least, above the level of the highest land to be irrigated; because that depth may be then kept as a surplus, in case of long-continued drought; being let in upon the first drain, by a very small penstock, made only to the depth of the first level. The water, when abundant, may flow both into the upper level, and over the weir, so as to make a fall. When the water is not wanted over the land, the penstock may be shut up altogether. It is to be remarked, that authors of eminence in this branch differ in opinion, though some suppose water to be more richly impregnated with vegetable sustenance, in proportion as it is taken nearer to the spring; provided the water be clear. The lands over which it is made to flow, will be benefited in exact proportion as they may be near to the first level, which will always receive the most obvious benefit. In foul streams, the result is usually found to be in an inverse ratio; the water being richer, in proportion as it is more remote from its source; but the first level will still receive the greatest portion of the benefit. Where rivers are very muddy, and of any magnitude, it is common to allow their flowing, to the depth of many feet, over low lands; so that, when kept stationary for a few hours, the fecula and sediment may be deposited; as is often the case, to the depth of many inches during a single tide; and give a new stratum of the finest soil. See WARPING.

These points must be well understood, because they form a very prominent feature in the practice of irrigation, and will be found highly worthy the notice of all who lay their lands down with that intention. But we must observe that many soils laying contiguous to streams, and well situated for irrigation are naturally so rich, as not to depend on any deposit from the waters for their annual produce: such require but moderate watering, and in some instances, more to be sheltered during the winter by complete inundation, than by refreshing flows. Where such prevail, the water ought to be admitted only when clear, and then from the very surface; in contra-distinction to poor, or dry soils, which want heart as well as moisture. The fact is, that by means of an artificial supply of water, the grass will shoot out far more early, which is an object of the utmost importance to most farmers and graziers; and the crop will be much heavier than on lands not so watered. But the hay from watered meadows is frequently coarse, and not much relished by the more delicate classes of cattle. However, store cattle, which indeed scarcely ever refuse whatever is offered, will consume it with avidity. Another objection to hay from watered meadows, is that being sometimes gritty in consequence of the sediment deposited by muddy water, it is in a measure injurious to the teeth of those animals, by which it is eaten. But the great importance of an early bite, for at least a month, in general, before other pastures are sufficiently forward to receive cattle, is of itself such a consideration as outweighs every objection, and causes watered meadows to yield double the rent given before they were subjected to irrigation. In many places the grass of watered meadows from the fifteenth of March to the fifteenth of May, lets from twenty to twenty-five shillings per acre. The crop is usually two tons, in all seasons: in dry ones it is not subject to the ordinary risk of being burnt up; and,

not only proves highly serviceable to the farmer himself, but to his neighbours; who thus obtain a supply of hay, when their own meadows have failed.

When land has been long watered, its qualities are meliorated considerably; but this is not the work of a day; and when the adjoining lands abound with coarse herbage, with water grasses especially, the crops will too frequently suffer by such vicinity. It will, at first view, appear strange, but it is nevertheless true, that swampy lands become firmer when regularly watered. In their natural state the water oozes upwards, and loosens the soil; but after the proper levels are found, and the catch drains are laid, so as to draw off the surplus water, the moisture is drawn downwards, and the finer parts get into the interstices, so as to compact the whole, and give a firm footing, where before even a sheep would have been bogged. We must, however, state, that though some watered meadows will bear cattle, it is by no means adviseable to let any thing heavier than a sheep feed upon them: the latter do little injury to the ridges, and by their close bite, as well as by their excellent manure, cause the grass to tiller forth, so as to form a close mat upon the soil. Whereas when large animals are allowed to tramp on the ridges, the borders of the drains are in general injured; and whenever, as will happen, the prints of their feet are left, the soil will become quaggy, and retain little pools which infallibly sour the grass, and negative the intention of watering. Hence clay soils are extremely difficult to improve by this operation; nor can such be reclaimed but by a very expensive course of draining, manuring, and breaking into a crumbly state: certainly clay soils may be formed into ridges, and grass may be made to grow upon them; but they will not produce sweet herbage; their surfaces will crack, their crops will be precarious, and their seasons for feeding must depend entirely on the dryness of the weather. Hence we may, in general terms, consider clay soils to be unfit for irrigation; the expence being great, and the money being more likely to yield a greater profit by other means; while their crops and pasturage are, in various points, of an inferior value.

But to proceed: the secondary drain, which supplies the whole of a field through which it passes, should be interrupted at every fall of four inches at farthest, by small sluices, or penstocks, and have small branch-drains cut to the right and left, in such manner as may cause the water to branch out into the whole expanse of its level. The turf cut from the surface of each drain, ought to be placed, face downwards, between it and the land it is to overflow; being made firm and level, by beating with the flat of a spade. As the penstocks are situated just below the lines of the branch-drains above described, they keep up the water, so as to fill, and to cause their overflowing into the next inferior talus or slope, as shewn in fig. 1 and 2, where A is the main drain, taken from the water-head or river, B; the drain C, C, C, C, shews the secondary drain, which, being on a declivity, would carry off all the water, were it not kept up at the places where the catch-drains, or branches D, D, D, D, proceed laterally from it, by the sluices E, E, E, E. By this means, any particular level, either 1, 2, 3, 4, may be irrigated at pleasure, without wetting the others; the water being kept on by the sluice above, and carried away by the sluice appertaining to each level respectively. Or, if other meads at some distance are to be watered, the secondary channel, having all its sluices open, will convey it to them without interruption, when all its sluices are opened.

It is evident, that in this manner the whole of the water is carried down to the lowest level: hence, it becomes a matter of no small importance to ascertain, that the whole shall either be absorbed or be carried off; so as not to injure the last level, which might otherwise be subjected to very considerable injury, were the inundation to be too long supported. The judicious computer will be cautious not to allow so much to remain, as may rot his grass in lieu of causing it to vegetate vigorously. This, in some situations, presents a very serious difficulty; for if the water is debarred free access to the lowest levels, they will be less fruitful than the others, which, exclusive of the great fecundity derived from first receiving the fluid, receive absolutely a larger portion of moisture. The greatest care is therefore requisite, to insure that the tail, or spent-water, shall be carried off. Where the declivity is considerable, and that the stream, or any other water-course, offers itself to receive such tail-water, at a due level beneath, there is no difficulty; but where the stream takes another course, and the descent is trifling, some artificial means must be resorted to. Perhaps no more simple or efficacious plan can be hit upon,

than that of forming a fish-pond, of a suitable extent and depth, to receive the tail-water; whereby the apprehended damage may be avoided, and a useful store be created.

We shall shew what we may term a truly ingenious device, whereby water may be laid upon lands that are above the level of the stream: it consists merely of an air-vessel, A, fig. 3, into which the water descends forcibly from the stream, B, and by compressing the air in the upper part, C, is itself forced to ascend through the conducting pipe, D, with such force as to rise to a level, E, far above that at which it formerly stood. This is the principle of the common fire-engine, which, we are all sensible, can, when exerted, throw water to a great height. By such means, the tail-water may also be forced up to such a level as may cause it to return into the stream.

Where the stream runs through the lands that are watered, and that its declivity is moderate, it will sometimes be found difficult to restore the tail-water to its level. To effect this with as little expence as possible, wooden pipes should be laid from the lowest level of the land along the bank of the stream, but carried horizontally on a bank, to such extent as may suffice to convey the tail-water to the surface of the surface. This, however, is not applicable to all situations; for where the stream is very slow, its declivity would be very trifling. Where that happens, the air vessel will be found a good plan, provided the height to which the water is to be returned, be not considerable. In many situations, a water-wheel might answer well; observing, that in deep, slow waters, that are broad, and under the speculator's own management, it will be best to throw a weir across, and then to let the whole body of the stream rush through a narrow slip, so as to turn a wheel placed immediately in the line of the water's run. By this device, the current may be made to pass that particular spot with sufficient velocity to turn a wheel; whereby water might either be raised out of the river, to supply a main drain, or the tail-water might be restored to the stream: in either case, one or more pumps would be necessary. (See fig. 4.)

The second mode of laying water over the land, is by means of ridges, whose centres are occupied by small horizontal drains, out of which the water, furnished by the main drain, is allowed to flow to the depth of about an inch down each side of the pitch. These ridges should be from four to six feet measurement for each face; the drain being about a foot broad, and four inches deep; thus the whole breadth of a pitch, declining each way equally, might occupy a base of about ten feet at the utmost. The declivities ought not to exceed an inch to the foot; in loose soils, not more than half an inch; else the finer parts will be washed away, and the drains, formed by the junctions of the ridges, will be filled up, whereby the water will be detained, and prevented from passing into the next level. Fig. 5, shews the profile, or section of a range of ridges on the same level, and fig. 6, displays an inclined plane, whereon ridges are formed in regular succession, the catch-drains being a little higher than the branch-drains of the next lower level, so that the latter may be filled from the former: the water thus gradually descending, until the whole is gradually absorbed by the successive ridges; or the surplus is carried off by a large catch-drain, made to direct it into some other succession of ridges, as seen in the ground-plan, fig. 7.

The reader will perceive, that the levels may lay in any direction, according to the cast of the land; and, that where water can be had at a due height, all the land below it may be watered. It matters not if a deep valley lay between two declivities, to be watered by the same spring. A pipe, of suitable diameter, being made to descend one face, and to rise up the other, will convey the stream with facility to any part; so as to re-assume the level on the opposite side. For further insight into that circumstance, see Fluids, Hydraulics, and Hydrostatics.

It often happens, that small rivers have a very winding course among little hills, banks, rocky masses, &c., and that they suddenly lose many feet of their altitude, owing to a fall, or steep declivity; while the lower parts of the stream, being more expanded, and the water being kept up by another impediment, perhaps a few hundred yards lower, offer a seemingly invincible impediment to the conducting it over the finely-formed planes, which present themselves on either bank. Here the difficulty is far less than at first sight is supposed; since, by making an outlet from the superior level of the stream, through the bank which separates it from the planes to be watered, an abundant and certain supply may be obtained. Thus in fig. 8, the upper level, A, and fall, B, are shewn, and

the place pointed out where a cut, C, should be made, whereby the whole of the inclined plane, D, might be irrigated to the greatest advantage; the surplus-water draining off into the lower level of still-water, E, from which it would not be possible to raise the water to the superior parts of the inclined plane, C D, without the aid of expensive machinery. This section will, we trust, prove completely satisfactory, by shewing how necessary it is to look back to superior levels, often within reach.

Under the head of compound irrigation, we consider the various changes of direction, attended with an intermixture of the several modes laid down for simple irrigation. In the former, we occasionally find the water caught several times by the same stream, which, being obstructed at its several turns by weirs, sluices, &c., enables us to abbreviate the succession of ridges. This is a matter of great importance, because it renders a less body of water, in the branch-drains of the first level, equal to every purpose, and obviates the mischief that sometimes attends upon a numerous succession of levels, when the quantity of water required for the whole is forced through the first, in which, by its weight and volume, the roots of the grass are denudated, and the finer parts of the soil completely washed away. It is far better to give the stream a second, or even a third, turn through the land, than to allow all the water, necessary to moisten six or seven successive levels, to pass through the first. A reference to fig. 9, will give some idea of this mode; by the courses of the dotted lines, and arrows, the various descents may be understood.

With respect to the season for watering land, so many varieties prevail, in consequence of soil, and of locality, that we can only observe, in general terms, that, where lands are to be inundated completely, by letting the water assume an unlimited range, and to expand over all parts which come under its level, such places require, during the winter season, to be kept well covered, that the frost may not attack the plants while saturated with moisture: if that were to happen, the whole would be destroyed; whereas, by a periodical inundation the grass is sheltered from frost; and, by drawing off the water as the spring advances, and at intervals of about ten days, when the weather is fair, such grass will shoot out vigorously, and afford a very early bite for cattle, at that season when green food is both valuable and scarce. The same principle may be followed, though the practice is different, in places watered by drains. In such, the greatest care ought to be taken to avoid throwing on the water while the air is frosty; but so soon as the weather opens, the ground ought to be moderately moistened. The sun's power should guide us to the frequency and quantity of water; nor should its quality be overlooked: water from warm soils will produce effects widely different from the streams flowing out of clay lands, or such as are impregnated with iron, &c. The best water usually rises out of gravelly or chalky lands. It is better to throw the water on early in the day, during cold weather, in order that the grass may dry well, and the danger apprehended from frosty nights be obviated; but in summer, the watering should take place late in the evening, whereby the ground will be cold, without danger of scorching the plants.

We have dwelt thus long on the subject of irrigation, under the conviction of its extreme importance: the reader may, under the head of AGRICULTURE, find a few additional remarks, which were given with the view to bringing all matters relating to farming under one general head, while we reserved this mechanical part to be separately treated, under its proper designation.

IRRITABILITY, in physiology, is the property peculiar to the muscles, by which they contract upon the application of certain stimuli, without a consciousness of action. Haller and other physiologists denominate that part of the human body irritable, which becomes shorter by being touched: *very* irritable, if it contracts upon a slight touch. They call that a sensible part of the human body, which, upon being touched, transmits the impression of it to the mind: on the contrary, they call that insensible, which being burnt, torn, cut, &c. occasions no sign of pain or convulsion, nor any sort of change in the situation of the body. It is inferred that the epidermis is insensible; that the true skin is the most sensible part of the body; that the fat and cellular membrane are insensible; and the muscular flesh sensible, the sensibility of which he ascribes rather to the nerves than the flesh itself. The tendons, having no nerves distributed among them, are deemed insensible. Irritability then is the distinguishing characteristic between the muscular and cellular fibres. Irritability differs from sensibility, and is not proportioned to it: the intestines

are less sensible than the stomach, but more irritable: the heart is very irritable, though it has but a small degree of sensation. The laws of irritability, according to Dr. Crichton, are: 1. After every action in an irritable part a state of rest, or cessation from motion must take place before the irritable part can be again incited to action. If by an act of volition we throw any of our muscles into action, that action can only be continued for a certain space of time; the muscle becomes relaxed, notwithstanding all our endeavours to the contrary, and remains a certain time in that relaxed state, before it can be again thrown into action. 2. Each irritable part has a certain portion or quantity of the principle of irritability which is natural to it, part of which it loses during action, or from the application of stimuli. 3. By a process wholly unknown to us it regains this lost quantity during its repose or state of rest. In order to express the different quantities of irritability in any part, we say that it is either more or less redundant, or more or less defective. It becomes redundant in a part when the stimuli which are calculated to act on that part are withdrawn, or withheld for a certain length of time, because then no action can take place: while, on the other hand, the application of stimuli causes it to be exhausted, or to be deficient, not only by exciting action, but by some secret influence, the nature of which has not yet been detected; for it is a circumstance extremely deserving of attention, that an irritable part or body may be suddenly deprived of its irritability by powerful stimuli, and yet no apparent cause of muscular or vascular action takes place at the time. Thus a certain quantity of spirits taken at once into the stomach kills almost as instantaneously as lightning does: the same thing may be observed of some poisons, as opium, laurel-water, the juice of some poisonous vegetables, &c. 4. Each irritable part has stimuli which are peculiar to it; and which are intended to support its natural action: thus blood, which is the stimulus proper to the heart and arteries, if by any accident it gets into the stomach, produces sickness or vomiting. 5. Each irritable part differs from the rest in regard to the quantity of irritability which it possesses. This law explains to us the reason of the great diversity which we observe in the action of various irritable parts: thus the muscles of voluntary motion can remain a long time in a state of action, and if it be continued as long as possible, another considerable portion of time is required before they regain the irritability they lost; but the heart and arteries have a more short and sudden action, and their state of rest is equally so. The circular muscles of the intestines have also a quick action and short rest. 6. All stimuli produce action in proportion to their irritating powers. As a person approaches his hand to the fire, the action of all the vessels in the skin is increased, and it glows with heat; if the hand be approached still nearer, the action is increased to such an unusual degree as to occasion redness and pain; and if it be continued too long, real inflammation takes place; but if this heat be continued, the part at last loses it irritability, and a sphacelus or gangrene ensues. 7. The action of every stimulus is in an inverse ratio to the frequency of its application. A small quantity of spirits taken into the stomach increases the action of its muscular coat, and also of its various vessels, so that digestion is thereby facilitated. If the same quantity, however, be taken frequently, it loses its effect. In order to produce the same effect as at first, a larger quantity is necessary; and hence the origin of dram-drinking. 8. The more the irritability of a part is accumulated, the more that part is disposed to be acted upon. It is on this account that the activity of all animals, while in perfect health, is much livelier in the morning than at any other time of the day; for during the night the irritability of the whole frame, and especially that of the muscles destined for labour, *viz.* the muscles of voluntary action, is re-accumulated. The same law explains why digestion goes on more rapidly the first hour after food is swallowed than at any other time; and it also accounts for the great danger that accrues to a famished person upon first taking in food. 9. If the stimuli which keep up the action of any irritable body be withdrawn for too great a length of time, that process on which the formation of the principle depends is gradually diminished, and at last entirely destroyed. When the irritability of the system is too quickly exhausted by heat, as is the case in certain warm climates, the application of cold invigorates the frame, because cold is a mere diminution of the overplus of that stimulus which was causing the rapid consumption of the principle. Under such, or similar circumstances, therefore, cold is a tonic remedy; but if in a climate naturally cold, a person were to go into a cold bath, and not

soon return into a warmer atmosphere, it would destroy life just in the same manner as many poor people, who have no comfortable dwellings, are often destroyed from being too long exposed to the cold in winter. Upon the first application of cold the irritability is accumulated, and the vascular system therefore is disposed to great action; but after a certain time all action is so much diminished, that the process, whatever it be, on which the formation of the irritable principle depends, is entirely lost. See Dr. Crichton on Mental Derangement for more on this subject.

ISATIS, in botany, a genus of the Tetradynamia Siliculosa class and order. Natural order of Siliqnosæ or Cruciformes. Cruciferæ, Jussieu. Essential character: silicle lanceolate, one-celled, one-seeded, deciduous, bivalve; valves navicular. There are five species, of which I. tinctoria, dyer's woad, is a biennial plant, with a fusiform, fibrous root: stem upright, round and smooth, woody at bottom, branched at top; stem leaves from two to three inches long, and scarcely half an inch in breadth; flowers small, terminating the stem and branches in a close raceme; both corolla and calyx yellow; petals notched at the end; seed vessels on slender peduncles, hanging down, chesnut coloured or dark brown, shining when ripe, of an oblong elliptic form, compressed at top and on the sides into a sharp edge, swelling like a convex lens in the middle; cotyledons ovate, fleshy, plano convex; radicle subcylindrical, bent in upwards. It is a native of most parts of Europe. Woad is much used by dyers for its blue colour: it is the basis of black and many other colours.

ISCHÆMUM, in botany, a genus of the Polygamia Monoecia class and order. Natural order of Gramina, or Grasses. Gramineæ, Jussieu. Essential character: hermaphrodite calyx; glume two-flowered; corolla two-valved; stamens three; styles three; seed one: male, calyx and corolla as in the other; stamens three. There are eight species.

ISERINE, in mineralogy, a species of the Menachine genus: it is of an iron-black, inclining a little to the brownish-black; it occurs in small, obtuse, angular grains, and in rolled pieces, with a rough glimmering surface. Internally it is glistering, and its lustre is semi-metallic. Specific gravity 4.5. Before the blow-pipe, it melts into a blackish-brown coloured glass, which is slightly attracted by the magnet. It is composed of

Oxide of menachine......	59.1
———— iron............	30.1
———— uran...........	10.2
	99.4
Loss.............	6
	100.0

It bears a great resemblance to iron-sand, in colour, but in specific gravity it differs, as also in its being very slighly attractable by a powerful magnet. It is found on high mountains in Germany.

ISERTIA, in botany, a genus of the Hexandria Monogynia class and order. Essential character: calyx coloured, four or six-toothed; corolla six-cleft, funnel form; pome sub-globular, six-celled, many seeded. There is but one species, viz. I. coccinea, a tree with a trunk ten or twelve feet in height, and about eight inches in diameter; the bark is wrinkled, and of a russet colour; the wood light, and of a loose texture; branches quadrangular, straight, with opposite branchlets, channelled and covered with a russet down; each branchlet has three flowers, of which that in the middle is sessile; calyx purplish; tube of the corolla two inches long, of a bright red; border yellow, covered on the inside with hairs of the same colour; fruit a succulent red berry or pome, the size of a cherry, sweet and good to eat. The wood is bitter; a decoction of the leaves is used by the Creoles in fomentations. It is common in the island of Cayenne; and on the continent of Guiana, flowering and bearing fruit a great part of the year.

ISINGLASS, used in medicine and domestic economy, is a preparation formerly made only from a fish named huso, a species of the Accipenser genus. We have, in the sixty-third volume of the transactions of the Royal Society, a full account of the mode of preparing this substance, of which we shall give an extract.

The sounds, or air-bladders, of fresh water fish in general, are preferred for this purpose, as being the most transparent, flexible, delicate substances. These constitute the finest sorts of isinglass; those called book and ordinary staple are made of the intestines, and probably of the peritonæum of the fish. The belluga yields the greatest quantity, as being the largest and most plentiful fish in the Muscovy rivers;

but the sounds of all fresh water fish yield, more or less, fine isinglass, particularly the smaller sorts, found in prodigious quantities in the Caspian sea, and several hundred miles beyond Astracan, in the Wolga, Yaik, Don, and even as far as Siberia, where it is called kle or kla by the natives, which implies a glutinous matter; it is the basis of the Russian glue, which is preferred to all other kinds for its strength. The sounds, which yield the finer isinglass, consist of parallel fibres, and are easily rent longitudinally; but the ordinary sorts are found composed of double membranes, whose fibres cross each other obliquely, resembling the coats of a bladder; hence the former are more readily pervaded and divided with subacid liquors; but the latter, through a peculiar kind of interwoven texture, are with great difficulty torn asunder, and long resist the power of the same menstruum; yet, when duly resolved, are found to act with equal energy in clarifying liquors.

Isinglass receives its different shapes in the following manner. The parts of which it is composed, particularly the sounds, are taken from the fish while sweet and fresh, slit open, washed from their slimy sordes, divested of every thin membrane which envelopes the sound, and then exposed to stiffen a little in the air. In this state, they are formed into rolls about the thickness of a finger, and in length according to the intended size of the staple: a thin membrane is generally selected for the centre of the roll, round which the rest are folded alternately, and about half an inch of each extremity of the roll is turned inwards. The due dimensions being thus obtained, the two ends of what is called short staple are pinned together with a small wooden peg; the middle of the roll is then pressed a little downwards, which gives it the resemblance of a heart-shape, and thus it is laid on boards, or hung up in the air to dry.

The sounds, which compose the long-staple, are longer than the former; but the operator lengthens this sort at pleasure, by interfolding the ends of one or more pieces of the sound with each other. The extremities are fastened with a peg, like the former; but the middle part of the roll is bent more considerably downwards, and, in order to preserve the shape of the three obtuse angles thus formed, a piece of round stick, about a quarter of an inch diameter, is fastened in each angle with small wooden pegs, in the same manner as the ends. In this state, it is permitted to dry long enough to retain its form, when the pegs and sticks are taken out, and the drying completed; lastly, the pieces of isinglass are colligated in rows, by running pack-thread through the peg-holes, for convenience of package and exportation. That called cake-isinglass is formed of the bits and fragments of the staple-sorts, put into a flat metalline pan, with a very little water, and heated just enough to make the parts cohere like a pancake when it is dried; but frequently it is overheated, and such pieces, as before observed, are useless in the business of fining. Experience has taught the consumers to reject them.

Isinglass is best made in the summer, as frost gives it a disagreeable colour, deprives it of weight, and impairs its gelatinous principles; its fashionable forms are unnecessary, and frequently injurious to its native qualities. It is common to find oily putrid matter, and exuviæ of insects, between the implicated membranes, which, through the inattention of the cellarman, often contaminate wines and malt-liquors in the act of clarification.

These peculiar shapes might probably be introduced originally with a view to conceal and disguise the real substance of isinglass, and preserve the monopoly; but, as the mask is now taken off, it cannot be doubted to answer every purpose more effectually in its native state, without any subsequent manufacture whatever, especially to the principal consumers, who hence will be enabled to procure sufficient supply from the British colonies. Until this laudable end can be fully accomplished, and as a species of isinglass, more easily produceable from the marine fisheries, may probably be more immediately encouraged, it may be manufactured as follows. The sounds of cod and ling bear great analogy with those of the accipenser genus of Linnæus and Artedi; and are in general so well known as to require no particular description. The Newfoundland and Iceland fishermen split open the fish as soon as taken, and throw the back bones with the sounds annexed, in a heap; but previously to incipient putrefaction, the sounds are cut out, washed from their slimes, and salted for use. In cutting out the sounds, the intercostal parts are left behind, which are much the best; the Iceland fishermen are so sensible of this, that they beat the bone upon a block with a thick stick, till the pockets, as they term them, come out easily, and thus preserve the sound entire. If the sounds have been

cured with salt, that must be dissolved by steeping them in water before they are prepared for isinglass; the fresh sound must then be laid upon a block of wood, whose surface is a little elliptical, to the end of which a small hair-brush is nailed, and with a saw knife the membranes on each side of the sound must be scraped off. The knife is rubbed upon the brush occasionally, to clear its teeth; the pockets are cut open with scissars, and perfectly cleansed of the mucous matter with a coarse cloth; the sounds are afterwards washed a few minutes in lime-water in order to absorb their oily principle, and lastly in clear water. They are then laid upon nets to dry, but if intended to resemble the foreign isinglass, the sound of the cod will only admit of that called book, but those of ling both shapes. The thicker the sounds are the better the isinglass.

ISIS, *coral*, in natural history, a genus of the Vermes Zoophyta class and order. Animal growing in the form of a plant; stem stony, jointed, the joints longitudinally striate, united by spongy or horny junctures, and covered by a soft porous cellular flesh or bark; mouth beset with oviparous polypes. There are six species. I. hippuris; with white striate joints and black junctures; it is found chiefly in the Indian seas, growing to rocks, and is from two inches to two feet long. I. entrocha; stem testaceous, round, with orbicular perforated joints and verticillate dichotomous branches. Inhabits the ocean. The stem is about the thickness of a finger, with crowded flat orbicular joints perforated in the centre, the perforation is pentangular, with the disk substriate from the centre; outer bark or flesh unequal, and surrounded with a row of tubercles; branches thin, dichotomous, continued, not jointed. Hence it is thought that those fossils, called entrochi, are specimens of this species of coral.

ISLAND, or ICELAND, *crystal*, a body famous among the writers of optics, for its property of a double refraction; but improperly called by that name, as it has none of the distinguishing characters of crystal, and is plainly a body of another class. Dr. Hill has reduced it to its proper class, and determined it to be of a genus of spars, which he has called, from their figure, parallelopipedia, and of which he has described several species, all of which, as well as some other bodies of a different genus, have the same properties. Bartholine, Huygens, and Sir Isaac Newton, have described the body at large, but have accounted it either a crystal or a talc; errors which could not have happened, had the criterions of fossils been at that time fixed; since Sir Isaac Newton has recorded its property of making an ebullition with aquafortis, which alone must prove that it is neither talc nor crystal, both those bodies being wholly unaffected by that menstruum. See CRYSTAL, ORYCTOLOGY, and TALC.

It is always found in form of an oblique parallelopiped, with six sides, and is found of various sizes, from a quarter of an inch to three inches or more in diameter. It is pellucid, and not much less bright than the purest crystal, and its planes are all tolerably smooth, though, when nicely viewed, they are found to be waved with crooked lines made by the edges of imperfect plates.

What appears very singular in the structure of this body, is, that all the surfaces are placed in the same manner, and consequently it will split off into thin plates, either horizontally or perpendicularly; but this is found on a miscroscopic examination, to be owing to the regularity of figure, smoothness of surface, and nice joining of the several small parallelopiped concretions, of which the whole is composed; and to the same cause is probably owing its remarkable property in refraction. See OPTICS, and REFRACTION.

It is very soft, and easily scratched with the point of a pin; it will not give fire on being struck against steel, and ferments and is perfectly dissolved in aquafortis. It is found in Iceland, from whence it has its name; and in France, Germany, and many other places. In England fragments of other spars are very often mistaken for it, many of them having in some degree the same property.

ISNARDIA, in botany, so named in memory of Mons. Antoine Danti d'Isnard, member of the Academy of Sciences, a genus of the Tetrandria Monogynia class and order. Natural order of Calycanthemæ. Salicariæ, Jussieu. Essential character: calyx four-cleft; corolla none; capsule four-celled, covered by the calyx. There is but one species, *viz.* I. palustris, which bears a great resemblance to peplis portulaca; it is creeping and floating; the flowers are axillary, opposite, sessile, and green. It is a native of Italy, France, Alsace, Russia, Jamaica, and Virginia, in rivers.

ISOCHRONAL, ISOCHRONE, or ISO-

CHRONOUS, is applied to such vibrations of a pendulum as are performed in the same space of time, as all the vibrations or swings of the same pendulum are, whether the arches it describes be longer or shorter: for when it describes a shorter arch it moves so much the slower, and when a long one proportionably faster.

ISOCHRONAL *line*, that in which a heavy body is supposed to descend without any acceleration.

M. Leibnitz shows, that an heavy body, with a degree of velocity acquired by the descent from any height, may descend from the same point by an infinite number of isochronal curves, all which are of the same species, differing from one another only in the magnitude of their parameters; such are all the quadrato-cubical paroboloids, and consequently similar to one another. He shows also there, how to find a line in which a heavy body descending shall recede uniformly from a given point, or approach uniformly to it.

ISOETES, in botany, a genus of the Cryptogamia Filices class and order. Natural order of Filices, or Ferns. Essential character: male, anther within the base of the frond: female, capsule two-celled, within the base of the frond. There are two species, *viz.* I. lacustris, common quillwort, and I. coromandelina, Coromandel quillwort, both natives of mountain lakes, and in wet places that are inundated in the rainy season.

ISOPERIMETRICAL *figures*, in geometry, are such as have equal perimeters, or circumferences.

Isoperimetrical lines and figures have greatly engaged the attention of mathematicians at all times. The fifth book of Pappus's Collections is chiefly upon this subject; where a great variety of curious and important properties are demonstrated, both of planes and solids, some of which were then old in his time, and many new ones of his own. Indeed, it seems, he has here brought together into this book all the properties relating to isoperimetrical figures then known, and their different degrees of capacity. The analysis of the general problem concerning figures, that, among all those of the same perimeter, produce maxima and minima, was given by Mr. James Bernoulli, from computations that involve the second and third fluxions. And several enquiries of this nature have been since prosecuted in like manner, but not always with equal success. Mr. Maclaurin, to vindicate the doctrine of fluxions from the imputation of uncertainty or obscurity, has illustrated this subject, which is considered as one of the most abstruse parts of this doctrine, by giving the resolution and composition of these problems by first fluxions only; and in a manner that suggests a synthetic demonstration, serving to verify the solution. See Maclaurin's Fluxions. Mr. Crane also, in the Berlin Memoirs for 1752, has given a paper in which he proposes to demonstrate, in general, what can be demonstrated only of regular figures in the elements of geometry, *viz.* that the circle is the greatest of all isoperimetrical figures, regular or irregular. We shall now mention a few of the properties of isoperimetrical figures.

1. Of isoperimetrical figures, that is the greatest that contains the greatest number of sides, or the most angles, and consequently a circle is the greatest of all figures that have the same ambit as it has.

2. Of two isoperimetrical triangles, having the same base, whereof two sides of one are equal, and of the other unequal, that is the greater whose two sides are equal.

3. Of isoperimetrical figures, whose sides are equal in number, that is the greatest which is equilateral and equiangular. From hence follows that common problem of making the hedging or walling that will wall in one acre, or even any determinate number of acres, a; fence or wall in any greater number of acres whatever, b. In order to the solution of this problem, let the greater number, b, be supposed a square; let x be one side of an oblong, whose area is a; then will $\frac{a}{x}$ be the other side; and $2\frac{a}{x} + 2x$ will be the ambit of the oblong, which must be equal to four times the square root of b; that is, $2\frac{a}{x} + 2x = 4\sqrt{b}$. Whence the value of x may be easily had, and you may make infinite numbers of squares and oblongs that have the same ambit, and yet shall have different given areas.

Let $\sqrt{b} = d$

Then $\frac{2a + 4xx}{x} = 4d$

$$a + 2xx = 2dx$$

$$2xx - 2dx = -a$$

$$xx - dx = -\frac{a}{2}$$

$$xx - dx + \tfrac{1}{4}dd = -\frac{a}{2} + \tfrac{1}{4}dd$$

$$x = \sqrt{-\frac{a}{2} + \tfrac{1}{4}dd} + \tfrac{1}{2}d$$

Thus if one side of the square be 10; and one side of an oblong be 19, and the other 1; then will the ambits of that square and oblong be equal, *viz.* each 40, and yet the area of the square will be 100, and of the oblong but 19.

ISOPYRUM, in botany, a genus of the Polyandria Polygynia class and order. Natural order of Multisilique. Ranunculaceæ, Jussieu. Essential character: calyx none; petals five; nectary trifid, tubular; capsule recurved, many-seeded. There are three species.

ISOSCELES *triangle*, in geometry, one that has two equal sides. See GEOMETRY.

ISSUE, in law, has many significations, sometimes being used for the children begotten between a man and his wife; sometimes for profit growing from amercements or fines; and sometimes for profits of lands or tenements; sometimes for that point of matter depending in a suit, when, in the course of pleading, the parties in the case affirm a thing on one side, and deny it on the other, they are then said to be at issue; all their debates being at last contracted into a single point, which may be determined either in favour of the plaintiff or defendant.

ISSUES, in surgery, are little ulcers made designedly by the surgeon in various parts of the body, and kept open by the patient for the preservation or recovery of his health.

ITCH, a cutaneous disease, supposed to be caused by an insect, a species of the genus Acarus, *viz.* A. scabiei, which, when viewed by a good microscope, is white with reddish legs; the four hind ones having a long bristle. It is found in the small pellucid vesicles with which the hands and joints of persons infected with the itch are covered. It appears to be not only the cause of the disorder, but the reason why it is so highly infectious.

ITCHING, an uneasy sensation, which occasions a desire of scratching the place affected. It is frequently a troublesome sensation, but more nearly allied to pleasure than pain. As pain is supposed to proceed from too great an irritation, so does itching proceed from a slight one. Certain species of itching excites people to many necessary actions, as the excretion of the feces and urine; coughing, sneezing, &c.

ITEA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Rhododendra, Jussieu. Essential character: capsule two-celled, two-valved, many-seeded; stigma emarginate. There are two species, *viz.* I. virginica. Virginian itea; and I. cyrilla, entire-leaved itea. These are both shrubs. Linnæus remarks, that the itea virginica has the appearance of the Padus; that the leaves are petioled and the flowers in terminating racemes. The stigma is headed in this species, whereas in the other it is bifid or double; the former is a native of North America; the latter of Carolina and Jamaica.

ITTRIA. This earth was discovered by Gadolin, a Swedish chemist, in a fossil, found at Ytterby, in Sweden, which has since received the name of gadolinite, and in which it is combined with silex and lime. The discovery was confirmed by Ekeberg, Klaproth, and Vauquelin; and the same earth has been discovered in some other fossils particularly combined with tantalium. In several of its properties ittria resembles glucine, particularly in forming salts of a sweet taste, and in being soluble in carbonate of ammonia; but it differs entirely in others.

The process followed by Vauquelin to obtain this earth from the gadolinite was to dissolve it, with the assistance of heat, in diluted nitric acid, pouring off the solution from the undissolved silex. The liquor is then evaporated to dryness by which any remaining silex and any oxide of iron is separated from combination with the acid. By redissolving the residuum in water, the compound of nitric acid and ittria is obtained: if there are any traces of iron, the liquor is either again evaporated to dryness or a little ammonia is added; and after the separation of the oxide of iron by yellow flakes, the solution is decomposed by ammonia, which precipitates the new earth. (Philosophical Magazine, vol. viii. p. 369.) The process employed by Klaproth is similar; nitro-muriatic acid being employed; the iron being removed by the action of succinate of soda; and the ittria being precipitated by carbonate of soda. (Analytical Essays, vol. ii. p. 47.)

Ittria is obtained in the form of a white powder, and is heavier than any other earth; its specific gravity according to Ekeberg being 4.842. It is not fusible alone, but with borax it forms a white glass.

It is not soluble in water, but it retains that fluid with considerable force.

Ittria combines with the acids; its salts, as has been remarked, having generally a sweetish taste. Several of them, too, are coloured, a property in which it differs from all the other earths.

The sulphate of ittria crystallizes in small brilliant grains, according to Klaproth, of a rhomboidal form, and of a colour inclining to an amethyst red. Their taste is sweet, becoming also astringent. They require from twenty-five to thirty parts of water, and are not more soluble in hot water. Their specific gravity is 2.79. The sulphuric acid is expelled by a red heat. Nitrate of ittria can scarcely be crystallized; it assumes a gelatinous consistence by evaporation, and becomes brittle when this jelly cools. Its taste is similar to that of the sulphate. The muriate is obtained nearly in the same form. The phosphate formed by complex affinity is insoluble. The acetite is a crystallizable salt of a pale red colour.

The salts of ittria are decomposed by the three alkalies, and by lime, astrontites, and barytes.

Ittria is not dissolved by the liquid alkalies, nor do they redissolve it when added in excess, after having precipitated it from its solutions. This affords a distinguishing character between it and glucine. It is soluble in the alkaline carbonates, particularly in the carbonate of ammonia.

Prussiate of potash throws down from its solution a granular precipitate, of a white or pearl-grey colour. It is also precipitated in grey flocculi by the watery or spirituous infusion of galls; but very slightly by the pure gallic acid. It is not affected by sulphuretted hydrogen, or hydro-sulphuret of ammonia added to its solutions.

The great specific gravity of this earth, its forming coloured salts, and being precipitated by the alkaline prussiates, and by tannin, from its solutions, in some measure connect it with the metals, and lead to the suspicion that it may be a metallic oxide.

The gadolinite is the only fossil that can be considered as belonging to the genus of which this earth is the base, for the yttrotantalite contains it in small quantity only, and is properly a metallic fossil belonging to the genus Tantalium. The gadolinite occurs massive, and disseminated its colour; is a deep greenish black. Its internal lustre is resplendent; it is opaque; its fracture is conchoidal; its hardness is such that it is not scratched by the knife; its specific gravity is 4.2. It intumesces before the blow-pipe, but is not fused. With nitric acid it forms a gelatinous solution. According to Klaproth it consists of ittria 59.75, silex 21.25, oxide of iron 17.5, argil 0.5, water 0.5. The analysis of it by Ekeberg and Vauquelin give the proportion of ittria rather less, and of silex and iron somewhat more.

IVA, in botany, a genus of the Monoecia Pentandria class and order. Natural order of Compositæ Nucamentaceæ. Corymbiferæ, Jussieu. Essential character: male, calyx common, three-leaved; corolla of the disk, one-petalled, five-cleft; receptacle with hairs or linear chaffs: female, in the ray, five, or fewer; corolla none; styles two, long; seeds naked, blunt. There are two species, *viz.* I. annua, annual iva; and I. frutescens, shrubby iva, or bastard Jesuits' bark tree.

JUBILEE, a time of public and solemn festivity among the ancient Hebrews. This was kept every fiftieth year: it began about the autumnal equinox, and was proclaimed by sound of trumpet throughout all the country. At this time all slaves were released, all debts annihilated, and all lands, houses, wives, and children, however alienated, were restored to their first owners. During this whole year all kind of agriculture was forbidden, and the poor had the benefit of the harvest, vintage, and other productions of the earth, in the same manner as in the sabbatic, or seventh year. As this was designed to put the Israelites in mind of their Egyptian servitude, and to prevent their imposing the like upon their brethren, it was not observed by the gentile proselytes.

The Christians, in imitation of the Jews, have likewise established jubilees, which began in the time of Pope Boniface VIII. in the year 1300, and are now practised every twenty-five years; but these relate only to the pretended forgiveness of sins, and the indulgencies granted by the church of Rome.

JUDGE. The judges are the chief magistrates in the law, to try civil and criminal causes. Of these there are twelve in England, *viz.* the Lord's Chief Justices of the Courts of King's Bench and Common Pleas; the Lord Chief Baron of the Exchequer; the three puisne or inferior judges of the two former courts, and the three puisne barons of the latter. By statute 1 Geo. III.

c. 23, the judges are to continue in their offices during their good behaviour, notwithstanding any demise of the crown (which was formerly held immediately to vacate their seats) and their full salaries are absolutely secured to them during the continuance of their commissions, by which means the judges are rendered completely independent of the king, his ministers, or his successors. A judge at his creation takes an oath that he will serve the king, and indifferently administer justice to all men, without respect of persons, take no bribe, give no counsel where he is a party, nor deny right to any, though the king or any other, by letters, or by expressed words, command the contrary, &c. and in default of duty, to be answerable to the king in body, land, and goods. Where a judge has an interest, neither he nor his deputy can determine a cause, or sit in court, and if he do, a prohibition lies.

Judges are punishable for wilful offences againt the duty of their situations; instances of which happily live only in remembrance.

A judge is not answerable to the king, or the party, for mistakes or errors in his judgment, in a matter of which he has jurisdiction.

JUDGMENT, among logicians, a faculty or rather act of the human soul, whereby it compares its ideas, and perceives their agreement or disagreement.

JUDGMENT. The opinion of the judges is so called, and is the very voice and final doom of the law; and, therefore, is always taken for unquestionable truth; or it is the sentence of the law pronounced by the court upon the matter contained in the record. Judgments are of four sorts, viz. 1. Where the facts are confessed by the parties, and the law determined by the court, which is termed judgment by demurrer. 2. Where the law is admitted by the parties, and the facts only are disputed, as in judgment upon a demurrer. 3. Where both the fact and the law arising thereon are admitted by the defendant, as in case of judgment by confession or default. 4. Where the plaintiff is convinced that fact or law, or both, are insufficient to support his action, and therefore abandons or withdraws his prosecution, as in case of judgment upon a nonsuit or retraxit. See WARRANT of ATTORNEY.

Judgments are either interlocutory or final. Interlocutory judgments are such as are given in the middle of a cause, upon some plea, proceeding, or default, which is only intermediate, and doth not finally determine or complete the suit; as upon dilatory pleas, when the judgment in many cases is that the defendant shall answer over, that is, put in a more substantial plea. Final judgments are such as at once put an end to the action, by declaring that the plaintiff hath either entitled himself, or hath not, to recover the remedy he sues for.

JUGLANS, in botany, *walnut tree*, a genus of the Monoecia Polyandria class and order. Natural order of Amentaceæ. Terebintaceæ, Jussieu. Essential character: male, calyx one-leafed, scale-form; corolla six-parted; filaments eighteen: female, calyx four-cleft, superior; corolla four-parted; styles two; drupe with a grooved nucleus. There are eight species, of which J. regia, common walnut, is a very large and lofty tree, with strong spreading boughs. There are several varieties, but they all vary again when raised from the seed, and nuts from the same tree will produce different fruit: persons, therefore, who plant the walnut for its fruit should make choice of the trees in the nurseries when they have their fruit upon them. In France, Switzerland, &c. the wood is in great request for furniture, as it was formerly in England, till the use of mahogany superseded it; it is in great repute with the joiner, for the best grained and coloured wainscot; with the gun-smith, for stocks; with the coach-maker, for wheels and the bodies of coaches; with the cabinet-maker, for inlayings, especially the firm and close timber about the root, which is admirable for flecked and cambleted works. To render this wood the better coloured, joiners put the boards into an oven after the batch is out, or lay them in a warm stable: and when they work it, polish it over with its own oil very hot, which makes it look black and sleek, and the older it is the more estimable. The husks and leaves being macerated in warm water, and the liquor poured on grass walks and bowling-greens will infallibly kill the worms, without endangering the grass. Not that there is any thing peculiarly noxious in this decoction; but worms cannot bear the application of any thing bitter to their bodies, which is the reason that bitters, such as gentian, are the best destroyers of worms lodged in the bodies of animals.

JUGULAR, in anatomy, an appellation given to two veins of the neck, which arise from the subclavians. See ANATOMY.

JUGULARES, in natural history, an order of fishes according to the Linnæan

system. The fishes of this order have their ventral fins situated before the pectoral fins, and, as it were, under the throat. They are mostly inhabitants of the sea. Their body is sometimes covered with scales, and sometimes not. With a very few exceptions, they have spines in the dorsal and anal fins, and their gills have bony rays. Of this order there are the following genera:

Blennius	Kurtus
Callyonimus	Trachinus
Gadus	Uranoscopus.

JULIAN *period*, in chronology, a system or period of 7980 years, found by multiplying the three cycles of the sun, moon, and indiction into one another. See CHRONOLOGY.

This period was called the Julian, not because invented by Julius Cæsar; since the Julian epocha was not received till the year 4669, but because the system consists of Julian years. This epocha is not historical but artificial, being invented only for the use of true epochas; for Scaliger considering that the calculation was very intricate in using the years of the creation, the years before Christ, or any other epocha whatever, in regard that another person could not understand what year this or that writer meant; to remove such doubts in the computation of time, he thought of this period: which commencing 710 years before the beginning of the world, the various opinions concerning other epochas may commodiously be referred to it. See EPOCHA.

The most remarkable uses of the Julian period are as follow: 1. That we can explain our mind to one another, for every year in this period has its peculiar cycles, which no other year in the whole period has; whereas, on the contrary, if we reckon by the years of the world, we must first enquire how many years any other reckons from the creation to the year of Christ, which multiple-inquisition is troublesome and full of difficulties, according to the method of other periods. 2. That the three cycles of the sun, moon, and indiction, are easily found in this period. 3. That if it be known how the chronological characters are to be found in this period, and how the years of any other epocha are to be connected with the years of it, the same characters also may, with little labour, be applied to the years of all other epochas.

JULUS, in natural history, a genus of insects of the order Aptera. Lip crenate, emarginate; antennæ moniliform; two feelers, filiform; body long, semi-cylindrical, consisting of numerous transverse segments; legs numerous, twice as many on each side as there are segments of the body. There are fourteen species, of which we shall notice the J. indus, or great Indian julus, which is six or seven inches long; found in the warmer parts of Asia and America, inhabiting woods and other retired places. It has 115 legs on each side, the body is ferruginous; legs yellow; the last segment of the body is pointed. The most common species is the J. sabulosus, about an inch and a quarter long; the colour brownish black, except the legs, which are pale or whitish; it is an oviparous animal; and the young when first hatched are small and white, and furnished with only three pair of legs, situated near the head, the remaining pairs, in all 120, do not make their appearance till some time after. This species inhabits Europe, and is found in damp places and in nuts. The juli tribe are nearly allied to the scolopendræ, or centipedes, but their body instead of being flattened, as in those insects, is nearly cylindrical, and every joint or segment is furnished with two pair of feet, the number on each side doubling that of the segments, but in the scolopendræ the number of joints and of feet is equal on each side. The eyes of the juli are composed of hexagonal convexities, as in most of the insect tribe, and the mouth is furnished with a pair of denticulated jaws. When disturbed the juli roll themselves up into a flat spiral: their general motion is rather slow and undulatory.

JUNCUS, in botany, *rush*, a genus of the Hexandria Monogynia class and order. Natural order of Tripetaloideæ. Junci, Jussieu. Essential character: calyx six-leaved; corolla none; capsule one-celled. There are twenty-nine species. The rushes have a simple grassy stem, without leaves or knots, or else knotty, with a sheathing leaf at each knot; flowers terminating or lateral, corymbed or panicled, with the branchlets spathaceous at the base.

These plants agree with the grasses in the glumes of their flowers, and the sheaths of their leaves; they differ in having the stems filled with pith, whereas in grasses it is hollow. The rushes form an intermediate link between the grasses and some of the liliaceous plants, as anthericum, &c.

They form naturally two divisions, one without leaves allied to scirpus, &c. and the other with leafy stems. But all classical

botanical writers, says Dr. Smith, have judiciously preserved this very natural genus entire, notwithstanding the capsule is in some species one-celled, in others three-celled. The sea-rushes are planted on the sea-banks in Holland; the roots running deep into the sand, and matting very much so as to hold it together. In the summer, when they are full grown, they cut them, and when dry work them into baskets.

JUNGERMANNIA, in botany, so named from Louis Jungermannus of Leipsic, Professor of Botany at Atorff, a genus of the Cryptogamia Algæ, Linnæus, class and order. Natural order of Hepaticæ, Jussieu. Thirty species of these mosses are arranged in five subdivisions, in the fourteenth edition of "Systema Vegetabilium." Dr. Withering has forty-eight species in the third edition of his "Arrangement of British Plants;" he says many of them are beautiful microscopic objects.

JUNGIA, in botany, so named from Joachim Jungius, M. D. a genus of the Syngenesia Polygamia Segregata class and order. Natural order of Compositæ Oppositifoliæ. Cinarocephalæ, Jussieu. Essential character: calyx common, three-flowered; receptacle chaffy; florets tubular, two-lipped; outer lip ligulate; inner two-parted. There is but one species, *viz.* J. ferruginea, the stems of which are woody, covered with a ferruginous down; leaves alternate, five-lobed, cordate at the base; lobes rounded, blunt; they are hirsute, and underneath hoary; panicle terminating, large, decompounded; heads of flowers small, heaped. It is a native of South America.

JUNIPERUS, in botany, *juniper-tree*, a genus of the Dioecia Monadelphia class and order. Natural order of Coniferæ. Essential character: male, calyx of the ament a scale; corolla none; stamina three: female, calyx three-parted; petals three; styles three; berry three-seeded, irregular, with the three tubercles of the calyx. There are twelve species; some of these are lofty handsome trees; but the J. communis, common juniper, is a low shrub, seldom more than three feet in height, sending out many spreading tough branches, inclining on every side, covered with a brown or reddish bark, with a tinge of purple. The male flowers are sometimes on the same plant with the females, but at a distance from them; they are commonly on distinct plants. The female flowers are succeeded by roundish berries, which are at first green, and when ripe are of a dark purple colour. They continue on the bush two years, and are sessile in the axil of the leaves. Juniper is common in all the northern parts of Europe, in fertile or barren soils, on hills or in valleys, in open sandy plains, or in moist and close woods. In England it is found chiefly on open downs, in a chalky or sandy soil.

IVORY, a hard, solid, and firm substance, of a white colour, and capable of a very good polish. It is the tusk of the elephant, and is hollow from the base to a certain height. It is brought to us from the East Indies, and from the coast of Guinea. Tusks are valuable in proportion to their size; and it is observed, that the Ceylon ivory, and that from the island of Achem, do not become yellow by wear, as all other ivory does: hence the teeth of these places bear a larger price than those of the coast of Guinea.

Ivory *black*, is prepared from ivory, or bones burnt in a close vessel. This, when finely ground, forms a more beautiful and deeper colour than lamp-black; but, in the common methods of manufacturing, it is apt to be adulterated with charcoal dust, so as to be almost, or altogether, unfit for use.

JUPITER, ♃, in astronomy, one of the superior planets, remarkable for its great brightness. See ASTRONOMY.

Jupiter is the brightest of all the planets except Venus. He moves from west to east in a period of 4332 days, exhibiting irregularities similar to those of Mars. Before he comes into opposition, and when distant from the sun about 115°, his motion becomes retrograde, and increases in swiftness till he comes into opposition. The motion then becomes gradually slower, and becomes direct when the planet advances within 115° of the sun. The duration of the retrograde motion is about 121 days, and the arch of retrogradation described is about 10°. But there is a considerable difference both in the amount and in the duration of this retrograde motion.

Jupiter has the same general appearance with Mars, only that the belts on his surface are much larger and more permanent. They are said to have been first discovered by Fontana and two other Italians; but Cassini was the first who gave a good account of them. Their number is very variable, as sometimes only one, and at others no fewer than eight, may be perceived. They are generally parallel to one

another, but not always so; and their breadth is likewise variable, one belt having been observed to grow narrow, while another in its neighbourhood has increased in breadth, as if the one had flowed into the other, and in this case Dr. Long observes, that a part of an oblique belt lay between them, as if to form a communication for this purpose. The time of their continuance is very uncertain, sometimes remaining unchanged for three months; at others, new belts have been formed in an hour or two. In some of these belts large black spots have appeared, which moved swiftly over the disk from east to west, and returned in a short time to the same place; from whence the rotation of this planet about its axis has been determined.

The figure of Jupiter is evidently an oblate spheroid, the longest diameter of his disk being to the shortest as 13 to 12. His rotation is from west to east, like that of the sun, and the plane of his equator is very nearly coincident with that of his orbit; so that there can scarcely be any difference of seasons in that planet. His rotation has been observed to be somewhat quicker in his aphelion than his perihelion. The axis of rotation is nearly perpendicular to the plane of the ecliptic, and the planet makes one revolution in about 9 h. 55′ and 37″. The changes in the appearances of these spots, and the difference in the time of their rotation, make it probable that they do not adhere to Jupiter, but are clouds transported by the wind, with different velocities, in an atmosphere subject to violent agitations.

Four little stars are observed around Jupiter, which constantly accompany him. Their relative situation is continually changing. They oscillate on both sides of the planet, and their relative rank is determined by the length of these oscillations. That one in which the oscillation is shortest is called the first satellite, and so on. These satellites are analogous to our moon. See Astronomy. They are all supposed to move in ellipses; though the excentricities of all of them are too small to be measured, excepting that of the fourth; and even this amounts to no more than 0.007 of its mean distance from the primary.

The orbits of these planets were thought by Galileo to be in the same plane with that of their primary: but M. Cassini has found that their orbits make a small angle with it; and as he did not find any difference in the place of their nodes, he concluded that they were all in the same place, and that their ascending nodes were in the middle of Aquarius. After observing them for more than thirty-six years, he found their greatest latitude, or deviation from the plane of Jupiter's orbit, to be 2° 55′. The first of these satellites revolves at the distance of 5.697 of Jupiter's semi-diameters, or 1′ 51″, as measured by proper instruments; its periodical time is 1d. 18h. 27′ 34″. The next satellite revolves at the distance of 9.017 semi-diameters, or 2′ 56″, in 3d. 13h. 13′ 43″; the third at the distance of 14.384 semi-diameters, or 4′ 42″, in 7d. 3h. 42′ 36″; and the fourth at the distance of 25.266, or 8′ 16″, in 16d. 16h. 32′ 09″. Since the time of Cassini it has been found that the nodes of Jupiter's satellites are not in the same place; and from the different points of view in which we have an opportunity of observing them from the earth, we see them sometimes apparently moving in straight lines, and at other times in elliptic curves. All of them, by reason of their immense distance, seem to keep near their primary, and their apparent motion is a kind of oscillation like that of a pendulum; going alternately from their greatest distance on one side to the greatest distance on the other, sometimes in a straight line, and sometimes in an elliptic curve.

When a satellite is in its superior semicircle, or that half of its orbit which is more distant from the earth than Jupiter is, its motion appears to us direct, according to the order of the signs; but in its inferior semi-circle, when it is nearer to us than Jupiter, its motion appears retrograde; and both these motions seem quicker the nearer the satellites are to the centre of the primary, slower the more distant they are, and at the greatest distance of all they appear for a short time to be stationary.

From this account of the system of Jupiter and his satellites, it is evident that occultations of them must frequently happen by their going behind their primary, or by coming in betwixt us and it. The former takes place when they proceed towards the middle of their upper semi-circle; the latter, when they pass through the same part of their inferior semi-circle. Occultations of the former kind happen to the first and second satellites; at every revolution, the third very rarely escapes an occultation; but the fourth more frequently, by reason of its greater distance.

It is seldom that a satellite can be discovered upon the disk of Jupiter, even by the best telescopes, excepting at its first entrance, when by reason of its being more directly illuminated by the rays of the sun than the planet itself, it appears like a lucid spot upon it. Sometimes, however, a satellite in passing over the disk appears like a dark spot, and is easily to be distinguished. This is supposed to be owing to spots on the body of these secondary planets; and it is remarkable, that the same satellite has been known to pass over the disk at one time as a dark spot, and at another so luminous that it could not be distinguished from Jupiter himself, except at its coming on and going off. When the satellites pass through their inferior semi-circles, they may cast a shadow upon their primary, and thus cause an eclipse of the sun to his inhabitants if there are any; and in some situations this shadow may be observed going before or following the satellite. On the other hand, in passing through their superior semi-circles, the satellites may be eclipsed in the same manner as our moon, by passing through the shadow of Jupiter; and this is actually the case with the first, second, and third of these bodies; but the fourth, by reason of the largeness of its orbit, passes sometimes above or below the shadow, as is the case with our moon.

The beginnings and endings of these eclipses are easily seen by a telescope when the earth is in a proper situation with regard to Jupiter and the sun; but when this or any other planet is in conjunction with the sun, the superior brightness of that luminary renders both it and the satellites invisible. From the time of its first appearing after a conjunction until near the opposition, only the immersions of the satellites into his shadow, or the beginnings of the eclipses, are visible; at the opposition, only the occultations of the satellites, by going behind or coming before their primary, are observable: and from the apposition to the conjunction, only the immersions, or end of the eclipses, are to be seen. This is exactly true in the first satellite, of which we can never see an immersion with its immediately subsequent emersion: and it is but rarely that they can be both seen in the second; as, in order to their being so, that satellite must be near one of its limits, at the same time that the planet is near his perihelion and quadrature with the sun. With regard to the third, when Jupiter is more than forty-six degrees from conjunction with, or opposition to the sun, both its immersions and immediately subsequent emersions are visible; as they likewise are in the fourth, when the distance of Jupiter from conjunction or opposition is twenty-four degrees.

JURATS, magistrates in the nature of Aldermen, for the government of several corporations. Thus we meet with the Mayor and Jurats of Maidstone, Rye, &c.

JURY, a certain number of persons sworn to inquire of and try some matter of fact, and to declare the truth upon such evidence as shall be laid before them. The jury are sworn judges upon all evidence in any matter of fact. Juries may be divided into two kinds, common and special. A common jury is such as is returned by the sheriff, according to the directions of the statute 3 George II. cap. 25, which appoints that the sheriff's officer shall not return a separate pannel for every separate cause, but one and the same pannel for every cause to be tried at the same assizes, containing not less than forty-eight, nor more than seventy-two jurors; and their names being written on tickets shall be put into a box or glass, and when each cause is called, twelve of those persons whose names shall be first drawn out of the box shall be sworn upon a jury, unless absent, challenged, or excused. When a sufficient number of persons are impannelled, they are then separately sworn well and truly to try the issue between the parties, and a true verdict give according to the evidence.

Special juries were originally introduced in trials at bar, when the causes were of too great nicety for the discussion of ordinary freeholders. To obtain a special jury, a motion is made in court, and a rule is granted thereupon, for the sheriff to attend the master, prothonotary, or other proper officer, with his freeholder's book, and the officer is to take indifferently forty-eight of the principal freeholders, in the presence of the attornies on both sides, who are each of them to strike off twelve, and the remaining twenty-four are returned upon the pannel.

Jurors are punishable for sending for, or receiving, instructions from either of the parties concerning the matter in question.

In causes of nisi prius, every person whose name shall be drawn, and who shall not appear after being openly called three times, shall, on oath made of his having been lawfully summoned, forfeit a sum not

exceeding 5*l*., nor less than 40*s*., unless some reasonable cause of absence be proved, by oath or affidavit, to the satisfaction of the judge. If any juror shall take of either party to give his verdict, he shall, on conviction, by bill or plaint, before the court where the verdict shall pass, forfeit ten times as much as he has taken; half to the King, and half to him who shall sue. A man who shall assault or threaten a juror for giving a verdict against him, is highly punishable by fine and imprisonment; and if he strike him in the court, in the presence of the judge of assize, he shall lose his hand and his goods, and the profits of his lands during life, and suffer perpetual imprisonment.

JURY *mast*, whatever is set up in room of a mast that has been lost in a storm or in an engagement, and to which a lesser yard, ropes, and sails are fixed.

JUSSIÆA, in botany, so named from Antoine de Jussieu, a genus of the Decandria Monogynia class and order. Natural order of Calycanthemæ. Onagræ, Jussieu. Essential character: calyx four or five-parted, superior; petals four or five, capsules four or five celled, oblong, gaping at the corners; seeds numerous, minute. There are eleven species. These are mostly herbaceous plants, natives of North and South America, also of the East and West Indies.

JUSTICE signifies he who is deputed by the King to do right by way of judgment.

Justices *in eyre*, in ancient times, were sent with commission into several counties to hear such causes especially as were termed pleas of the crown. And this was done for the ease of the people, who must otherwise have been hurried to the King's Bench, if the case were too high for the county court: they differed from the justices of oyer and terminer, because they were sent upon one or for special causes and to one place; whereas the justices in eyre were sent through the province and counties of the land, with more indefinite and general commissions.

Justices *of gaol delivery*, such as are sent with commission to hear and determine all causes appertaining to such as for any offence are cast into the gaol.

Justices *of nisi prius*, are the same with justices of assize, for it is a common adjournment of a cause, to put it off to such a day, *nisi prius justiciarii venerint ad eas partes ad capiendas assisas;* and upon this clause of adjournment, they are called justices of *nisi prius*, as well as justices of assize, by reason of the writ or action they have to deal in.

Justices *of oyer and terminer*. As the justices of assize and *nisi prius* are appointed to try civil cases, so are the justices of oyer and terminer, and gaol delivery, to try indictments for all crimes all over the kingdom, at what are generally denominated the circuits or assizes; and the towns where they come to execute their commission are called the assize towns, and are generally the county towns.

Justices *of the peace*, are persons appointed by the King's commission, to attend to the peace of the county where they dwell. They were called guardians of the peace till the thirty-sixth year of Edw. III. c. 12, where they are called justices. A justice of the peace must, before he acts, take the oath of office, which is usually done before some persons in the county, by virtue of a *dedimus protestatem* out of chancery. Sheriffs, coroners, attorneys, and proctors, may not act as justices of the peace.

The power, office, and duty of this magistrate extends to an almost infinite number of instances, specified in some hundreds of acts of parliament, and every year accumulating. The commission of the peace does not determine by the demise of the King, nor until six months after, unless sooner determined by the successor: but before his demise, the King may determine it; or may put out any particular person, which is most commonly done by a new commission, leaving out such person's name.

Justices of the peace can only be appointed by the King's special commission, and such commission must be in his name; but it is not requisite that there should be a special suit or application to, or warrant from the King for the granting it, which is only requisite for such as are of a particular nature, as constituting the mayor of such a town and his successors perpetual justices of the peace within their liberties, &c. which commissions are neither revocable by the King, nor determinable by his demise, as the common commission of the peace is, which is made of course by the Lord Chancellor according to his discretion.

The form of the commission of the peace, as it is at this day, was, according to Hawkins, settled by the judges about 23 Elizabeth.

Justices of the peace have no power to hear and determine felonies, unless they are

authorized so to do by the express words of their commissions; and that their jurisdictions to hear and determine murder, manslaughter, and other felonies and trespasses, is by force of the express words in their commission.

But though justices of the peace by force of their commission have authority to hear and determine murder and manslaughter, yet they seldom exercise a jurisdiction herein, or in any other offences in which clergy is taken away, for two reasons: 1. By reason of the monition and clause in their commission, *viz.* in cases of difficulty to expect the presence of the justices of assize. 2. By reason of the direction of the statute of 1 and 2 Philip and Mary, c. 13, which directs justices of the peace, in case of manslaughter and other felonies, to take the examination of the prisoner, and the information of the fact, and put the same in writing, and then to bail the prisoner if there be cause, and to certify the same with the bail, at the next general gaol delivery; and therefore in cases of great moment they bind over the prosecutors, and bail the party, if bailable, to the next general gaol delivery; but in smaller matters, as petty larceny, and in some other cases, they bind over to the sessions, but this is only in point of discretion and convenience, not because they have not jurisdiction of the crime.

As to inferior offences, the jurisdiction herein given to justices of the peace by particular statutes, is so various, and extends to such a multiplicity of cases, that it would be endless to endeavour to enumerate them; also they have as justices of the peace a very ample jurisdiction in all matters concerning the peace. And therefore not only assaults and batteries, but libels, barratry, and common night-walking, and haunting bawdy-houses, and such like offences, which have a direct tendency to cause breaches of the peace, are cognizable by justices of the peace, as trespasses within the proper and natural meaning of the word.

On renewing the commission of the peace (which generally happens when any person is newly brought into it) a writ of *dedimus protestatem* is issued out of chancery to take the oath of him who is newly inserted, which is usually in a schedule annexed, and to certify the same into that court at such a day as the writ commands. Unto which oath are usually annexed the oaths of allegiance and supremacy.

Justices of the peace are to hold their sessions four times in the year, *viz.* the first week after Michaelmas, the Epiphany, Easter, and St. Thomas. They are justices of record, for none but justices of record can take a recognizance of the peace. Every justice of the peace has a separate power, and may do all acts concerning his office apart and by himself; and even may commit a fellow justice upon treason, felony, or breach of the peace. By several statutes, justices may act in many cases where their commission does not reach; the statutes themselves being a sufficient commission.

Justices of the peace are authorized to do all things appertaining to their office, so far as they relate to the laws for the relief, maintenance, and settlement of the poor; for passing and punishing vagrants; for repair of the highways, or to any other laws concerning parochial taxes, levies, or rates; notwithstanding they are rated or chargeable with the rates, within any place affected by such their acts. Provided that this shall not empower any justice for any county at large, to act in the determination of any appeal to the quarter sessions of such county, from any order, matter, or thing, relating to any such parish, township, or place, where such justice is so charged or chargeable, 16 Geo. II. c. 18. The power of justices is ministerial, when they are commanded to do any thing by a superior authority, as the court of Banco Regis, &c. In all other cases they act as judges; but they must proceed according to their commission, &c. Where a statute requires an act to be done by two justices, it is an established rule, that if the act be of a judicial nature, or the result of discretion, the two justices must be present to concur and join in it, otherwise it will be void; as in the orders of removal and filiation, the appointment of overseers, and the allowance of the indenture of a parish apprentice; but where the act is merely ministerial, they may act separately, as in the allowance of a poor-rate. This is the only act of two justices which has been construed to be ministerial; and the propriety of this construction has been justly questioned.

Where a justice shall exceed his authority in granting a warrant, the officer must execute it, and he is indemnified for so doing; but if it be in a case wherein he has no jurisdiction, or in a matter whereof he has no cognizance, the officer ought not to execute such warrant; for the officer is bound to take notice of the authority and

jurisdiction of the justice. If a justice of the peace will not, on complaint to him made, execute his office, or if he shall misbehave in his office, the party grieved may move the Court of King's Bench for an information, and afterwards may apply to the Court of Chancery to put him out of the commission. But the most usual way of compelling justices to execute their office, in any case, is by writ of mandamus out of the Court of King's Bench.

Where the plaintiff in an action against a justice shall obtain a verdict, and the judge shall in open court certify on the back of the record, that the injury for which such action was brought was wilfully and maliciously committed, the plaintiff shall have double costs. And if a justice of peace act improperly, knowingly, information shall be granted. No justice shall be liable to be punished both ways, that is, criminally and civilly; but before the court will grant an information, they will require the party to relinquish his civil action, if any such be commenced. And even in the case of an indictment, and though the indictment be actually found, the Attorney General, on application made to him, will grant a *noli prosequi* upon such indictment, if it appear to him that the prosecutor is determined to carry on a civil action at the same time.

If any action shall be brought against a justice for any thing done by virtue of his office, he may plead the general issue, and give the special matter in evidence; and if he recover, he shall have double costs. Such action shall not be laid but in the county where the fact was committed. And no suit shall be commenced against a justice of the peace till after one month's notice. And unless it is proved upon the trial that such notice was given, the justice shall have a verdict and costs. And no action shall be brought against any constable or other officer, or any person acting by his order and in his aid, for any thing done in obedience to the warrant of a justice, till demand hath been made, or left at the usual place of his abode, by the party or by his attorney, in writing, signed by the party demanding the same, of the perusal and copy of such warrant, and the same has been refused or neglected for six days after such demand. And no action shall be brought against any justice for any thing done in the execution of his office, unless commenced within six months after the act committed.

JUSTICIA, in botany, so named from James Justice, a genus of the Diandria Monogynia class and order. Natural order of Personatæ. Acanthi, Jussieu. Essential character: corolla ringent; capsule two-celled, opening with an elastic claw; stamina with a single anther. There are eighty species, mostly natives of the Cape of Good Hope and the East Indies. There are only two commonly known in our English gardens, *viz.* J. adhatodar, Malabar nut; and J. hyssopifolia, snap tree.

JUSTICIES is a writ directed to the sheriff to do justice in a plea of trespass *vi et armis*, or of any sum above 40*s.* in the county court, of which he hath no cognisance by ordinary power. It is in the nature of a commission to the sheriff, and is not returnable.

IXIA, in botany, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ. Irides, Jussieu. Essential character: corolla one-petalled, tubular; tube straight, filiform; border six-parted, bell-shaped, regular; stigmas three or six, simple. There are fifty four species. Ixia differs from antholyza in having the segments of the corolla nearly equal; from gladiolus, in the situation of the segments of the corolla, and in having the tube straight. Almost all the species are natives of the Cape of Good Hope.

IXORA, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Stellatæ. Rubiaceæ, Jussieu. Essential character: corolla one-petalled, funnel-form, long, superior; stamina above the mouth; berry four-seeded. There are nine species, of which I. Americana, American ixora, has a shrubby stalk, four or five feet high, sending out slender opposite branches; leaves nearly six inches long, on short foot stalks. Flowers at the ends of the branches in a loose spike; they are white, and have a scent like jasmine, whence in Jamaica and other islands of the West Indies, where it is a native, it is called wild jasmine.

K.

K, Or k, the tenth letter, and seventh consonant of our alphabet; being formed by the voice, by a guttural expression of the breath through the mouth, together with a depression of the lower jaw, and opening of the teeth.

Its sound is much the same with that of the hard *c*, or *qu*; and it is used, for the most part, only before *e*, *i*, and *n*, in the beginning of words; as, *ken*, *kill*, *know*, &c. It used formerly to be always joined with *c* at the end of words, but is at present very properly omitted: thus, for *publick*, *musick*, &c. we say, *public*, *music*, &c. However, in monosyllables it is still retained, as *jack*, *block*, *mock*, &c.

The letter *k* is derived from the Greek kappa, K or κ; it being unknown to the Romans, though we sometimes meet with kalendæ instead of calendæ.

As a numeral K denotes 250; and with a line over it, $\bar{K}$ 250,000.

KÆMPFERIA, in botany, so named from Engelbert Kæmpfer, a celebrated traveller, a genus of the Monandria Monogynia class and order. Natural order of Scitamineæ. Cannæ, Jussieu. Essential character: corolla six-parted, three of the parts larger, spreading, one two-parted; stigma two-plated. There are two species, viz. K. galanga, galangale; and K. rotunda. As these are both natives of the East Indies, they require a warm stove to preserve them through our winter.

KALI. See ALKALI and POTASH.

KALMIA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Bicornes. Rhododendra, Jussieu. Essential character: calyx five-parted; corolla salver form, with the border five-horned beneath; capsule five-celled. There are four species, of the K. latifolia, broad-leaved kalmia, we shall give some little account, taken from the fifth volume of the American Philosophical Transactions. The leaves of this shrub are feasted upon by the deer and the round horned elk, but are mortally poisonous to sheep, to horned cattle, to horses, and to man. The bee extracts honey, without injury, from its nectary, but the man who partakes of that honey after it is deposited in the hive cells, falls a victim to his repast.

Some very singular cases in proof of this assertion occurred at Philadelphia no longer ago than the year 1790, in the autumn and winter of which an extensive mortality was produced amongst those who had partaken of the honey that had been collected in the neighbourhood of Philadelphia, or had feasted on the common American pheasant. The attention of the American government was excited by the general distress, a minute examination into the cause of the mortality ensued, and it was satisfactorily ascertained, that the honey had been chiefly extracted from the flowers of kalmia latifolia, and that the pheasants which had proved thus poisonous had fed harmlessly on its leaves; in consequence of which, a public proclamation was issued, prohibiting the use of the pheasant, as a food, for that season. See Good's Oration before the Medical Society.

KAMSIN, the name of a hot southerly wind, common in Egypt. The wind is said to prevail more or less for fifty days, hence it is called "the wind of fifty days." Travellers who have experienced the effect of it have described it as a poisonous wind. When it begins to blow, the atmosphere assumes an alarming appearance. The sky, at other times so clear in this climate, becomes dark and heavy; the sun loses its splendour, and appears of a violet colour; the air is not cloudy, but grey and thick, and is filled with a dust so subtile, that it penetrates every where.

This wind, always light and rapid, is not at first remarkably hot, but it increases in heat in proportion as it continues. All animated bodies soon discover it by the change it produces in them. The lungs, which a too rarefied air no longer expands, are contracted, and become painful. Respiration is short and difficult, the skin parched and dry, and the body consumed by an internal heat. In vain is recourse had to large draughts of water; nothing can restore perspiration. In vain is coolness sought for; all bodies, in which it is usual to find it, deceive the hand that touches them. Marble, iron, water, notwithstanding the sun no

longer appears, are hot. The streets are deserted, and the dead silence of night reigns every where. The inhabitants of towns and villages shut themselves up in their houses, and those of the desert in their tents, or in wells dug in the earth, where they wait the termination of this destructive heat. It usually lasts three days, but if it exceeds that time it becomes insupportable. The danger is most imminent when it blows in squalls; for then the rapidity of the wind increases the heat to such a degree as to cause sudden death. This death is a real suffocation. The lungs being empty are convulsed, the circulation is disordered, and the whole mass of blood driven by the heat towards the head and breast; whence the hæmorrhage at the nose and mouth, which happens after death. This wind is especially destructive to persons of a plethoric habit, and those in whom fatigue has destroyed the tone of the muscles and the vessels. The corpse remains a long time warm, swells, turns blue, and soon becomes putrid. These accidents are to be avoided by stopping the nose and mouth with handkerchiefs. An efficacious method, likewise, is that practised by the camels. On this occasion these animals bury their noses in the sand, and keep them there till the squall is over. Another quality of this wind is its extreme aridity; which is such, that water sprinkled on the floor evaporates in a few minutes. By the extreme dryness it withers and strips all the plants; and by exhaling too suddenly the emanations from animal bodies, crisps the skin, closes the pores, and causes that feverish heat which is the constant effect of suppressed perspiration.

KAOLIN, in the arts, the name of an earth used in the manufacture of oriental porcelain china. A specimen of this earth was brought from China, and examined by Reaumur, who found it to be infusible by fire. He thought it was a talcy earth; but Mr. Macquer says, it is more probably of an argillaceous nature, from its forming a tenacious paste, with the other ingredient called petunse, which has no tenacity. A French chemist, M. Bomaire, analized it, and found it was a compound earth consisting of clay, to which it owed its tenacity; of calcareous earth, which gave it a mealy appearance; of sparkling crystals of mica; and of small gravel, or particles of quartz-crystals. He found a similar earth upon a stratum of granite, and conjectures it may be a decomposed granite.

KEDGING, in the sea-language, is when a ship is brought up or down a narrow river by means of the tide, the wind being contrary. To do this, they use to set their fore-course, or fore-top-sail and mizen, that so they may flat her about; and if she happen to come too near the shore, they let fall a kedge-anchor, with a hawser fastened to it from the ship, in order to turn her head about; which work is called kedging.

KEEL, the lowest piece of timber in a ship, running her whole length from the lower part of her stem to the lower part of her stern-post. Into it are all the lower futtocks fastened; and under part of it a false keel is often used.

By comparing the carcass of a ship to the skeleton of a human body, the keel appears as the back bone, and the timbers as the ribs. Accordingly, the keel supports and unites the whole fabric, since the stem and stern-posts, which are elevated on its ends, are, in some measure, a continuation of the keel, and serve to connect and inclose the extremities of the sides by transoms, as the keel forms and unites the bottom by timbers.

The keel is generally composed of several thick pieces placed lengthways, which, after being scarfed together, are bolted and clinched upon the upper side.

KEEL *hauling*, a punishment inflicted for various offences in the Dutch navy. It is performed by suspending the culprit by a rope from one yard-arm, with a weight of lead or iron upon his legs, and having another rope fastened to him, leading under the ship's bottom, and through a block at its opposite yard-arm; he is then repeatedly and suddenly let fall from the one yard-arm into the sea, where, passing under the ship's bottom, he is hoisted upon the opposite side of the vessel to the other.

KEELERS, among seamen, are small tubs, which hold stuff for the caulking of ships.

KEELSON, a principal timber in a ship, fayed within-side cross all the floor-timbers; and being adjusted to the keel with suitable scarfs, it serves to strengthen the bottom of the ship.

KEEP, in ancient military history, a kind of strong tower, which was built in the centre of a castle or fort, to which the besieged retreated, and made their last efforts of defence.

Of this description is the keep of Windsor Castle.

KEEPER *of the great seal*, is a lord by virtue of his office, and styled the Lord Keeper of the Great Seal of England. He is one of the King's Privy Council, through whose hands pass all charters, commissions, and grants of the King under the great seal; without which, all such instruments by law are of no force, the King in this being a corporation, whose acts are evidenced by his seal. This Lord Keeper, by the statute of 5 Elizabeth, cap. 18, has the same place, authority, pre-eminence, &c. as the Lord Chancellor of England for the time being. He is constituted by the delivery of the great seal to him, taking his oath.

Keeper *of the privy seal*, is a lord by virtue of his office, through whose hands pass all charters signed by the King before they come to the great seal. He is of the King's Privy Council, and was anciently called Clerk of the Privy Seal.

KEEPING, in painting, signifies the representation of objects in the same manner that they appear to the eye at different distances from it, which is only to be done with accuracy by attending to the rules of perspective.

KELP, an impure alkali, obtained in the north of Scotland, from different kinds of fucl, or sea-weed. The sea-weeds being dried, are put in pits dug in the sand, or on the surface, surrounded with loose stone, forming what is called a kiln; fresh quantities being added, and the whole being frequently stirred until it become semi fluid, which, when cold, forms hard masses.

Kelp, a fixed salt, or particular species of a potash, procured by burning the weed called kali.

KERMES, in natural history, a species of the Coccus, which see.

Kermes *mineral*, in chemistry, an antimonial compound of great celebrity as a medicine about the beginning of the seventeenth century; in the new chemical arrangement it is denominated hydro-sulphuret of antimony.

The substance is prepared in the following manner: sixteen parts of sulphuret of antimony, eight parts of potash, and one of sulphur, are triturated together in a mortar, melted in a crucible, and the mass poured into an iron vessel. When cold it is pounded, and boiled in a sufficient quantity of water, and the solution is filtered while hot. On cooling, it deposits the kermes abundantly in the state of a yellow powder, which is edulcorated with a sufficient quantity of water, and dried. The true kermes consists of

Sulphuretted hydrogen......	20.30
Sulphur	4.15
Protoxide of antimony	72.76
Water, and loss	2.79
	100.00

KETCH, a vessel equipped with two masts, *viz.* the main-mast and the mizen-mast, and usually from 100 to 250 tons burthen. Ketches are principally used as yachts for conveying princes of the blood, ambassadors, or other great personages, from one place to another. Ketches are likewise used as bomb-vessels, and are therefore furnished with all the apparatus necessary for a vigorous bombardment.

Ketches, *bomb*, are built remarkably strong, as being fitted with a greater number of riders than any other vessel of war; and indeed this reinforcement is absolutely necessary to sustain the violent shock produced by the discharge of their mortars, which would otherwise in a very short time shatter them to pieces.

KEY, a well known instrument for opening and shutting the locks of doors, chests, &c. See Lock.

Key, or *key note*, in music, a certain fundamental note or tone, to which the whole of a movement has a certain relation or bearing, to which all its modulations are referred and accommodated, and in which it both begins and ends. There are but two species of keys: one of the major, and one of the minor mode: all the keys in which we employ sharps or flats being deduced from the natural keys of C major and A minor; of which they are mere transpositions.

Keys *of an organ*, those moveable, projecting levers in the front of an organ, so placed as to conveniently receive the fingers of the performer, and which, by a connected movement with the valves or pallets, admit or exclude the wind from the pipes. When a single key of an organ is pressed down, as many sounds are heard as all the stops which are then out furnish to that key; in other words, all those pipes are heard which are permitted by those stops and that key to receive the wind.

Key *stone* of an arch, or vault, that placed at the top or vertex of an arch, to bind the two sweeps together. This, in the Tuscan and Doric orders, is only a plain stone, projecting a little; in the Ionic it is cut and waved somewhat like consoles; and

in the Corinthian and Composite orders it is a console, enriched with sculpture. Key-stones, made in the manner of consoles, and placed projecting in the middle of arches and porticos, are particularly designed to sustain the weight and pressure of the entablature, where it happens to be very great between the columns; for which reason, they should be made so as to be a real support, and not stand for mere ornaments, as they too frequently do.

KIDNAPPING, is the forcibly taking and carrying away a man, woman, or child, from their own country, and sending them to another. This is an offence at common law, and punishable by fine, imprisonment, and pillory. By statute 11 and 12 William III. c. 7, if any captain of a merchant vessel shall, during his being abroad, force any person on shore, and wilfully leave him behind, or refuse to bring home all such men as he carried out, if able and desirous to return, he shall suffer three months imprisonment. Exclusive of the above punishment for this, as a criminal offence, the party may recover upon an action for compensation in damages for the civil injury.

KIGGELARIA, in botany, so named from Francis Kiggelar of Holland, a genus of the Dioecia Decandria class and order. Natural order of Columniferæ. Euphorbiæ, Jussieu. Essential character: male, calyx five-parted; corolla five-petalled; glands five, three-lobed; anthers perforated at the tip: female, calyx and corolla as in the male; styles five; capsule one-celled, five-valved, many-seeded. There is but one species, *viz.* K. africana. This plant grows naturally at the Cape of Good Hope, where it rises to a tree of middling stature; the branches have a smooth bark, which is at first green, afterwards it changes to a purplish colour: the leaves are about three inches long and one broad, sawed on their edges, standing upon short foot-stalks alternately. The flowers come out in clusters from the side of the branches, hanging downwards: they are of an herbaceous white colour, appearing in May, at which time the plants are thinly garnished with leaves, most of the old ones dropping off just before the new leaves appear. The male flowers fall away soon after their farina is shed; but the hermaphrodite, or female flowers are succeeded by globular fruit the size of common red cherries; the cover of these is very rough, and of a thick consistence, opening in five valves at the top, having one cell filled with small angular seeds. These fruits have grown to their full size in the Chelsea garden; but the seeds have rarely come to maturity.

KILDERKIN, a liquid measure, containing two firkins, or eighteen gallons.

KING *of England.* The executive power in England is vested in a single person by immemorial usage, to whom the care of the people is entrusted, and to whom, therefore, allegiance is due. Formerly the succession being interrupted, there was occasionally a distinction between a rightful king, or king *de jure*, and a king in possession of the throne, or king *de facto*; and in cases of treason, and also with respect to many acts done by kings *de facto*, which were necessary to be recognised by kings *de jure* afterwards, this distinction was of great importance: but it seems now only necessary to consider the rightful power and authority of the King, lawfully and peaceably in possession of the throne. And in this country the crown is by common law hereditary in a peculiar manner, but not *de jure divino*; and it may be changed in the limitation of its descent by the authority of the King, Lords, and Commons in parliament assembled, but it is not elective. As to the mode of inheritance, it is generally the same as other feodal descents, but it differs in one or two particulars; for it descends regularly to lineal descendants by right of primogeniture: but in case of no male heir, it descends to the eldest daughter only, and to her issue, and not in coparcenary to all the daughters. In failure of lineal heirs it goes to collateral descendants, but there is no failure on account of half blood. Lands also purchased by the King descend with the crown. The inheritance is not indefeasable, but may be altered as above, and therefore the statutes have expressed "his Majesty, his heirs, and successors." But however limited or transferred, it still retains its hereditable quality to the wearer of it; and hence the King never dies, but his right vests *eo instanti* in his heir; so that Hall says, there can be no interregnum, and the death of the King is called the demise of the crown, which ordinarily means only a transfer from one to another. If the throne becomes vacant, whether by abdication, as in the time of James II., or by failure of all heirs, the two houses of parliament may, it is said by Blackstone, dispose of it.

The preamble to the bill of rights expressly declares, that the lords spiritual and temporal, and commons, assembled at

Westminster, lawfully, fully, and freely represent all the estates of the people of this realm. The lords are not less the trustees and guardians of their country than the members of the House of Commons. It was justly said, when the royal prerogatives were suspended, during his Majesty's illness in 1788, that the two houses of Parliament were the organs by which the people expressed their will: and in the House of Commons, on the 16th of December, in that year, two declaratory resolutions were accordingly passed, importing, 1. The interruption of the royal authority; 2. That it was the duty of the two Houses of Parliament to provide the means of supplying that defect. On the 23d of the same month a third resolution passed, empowering the Lord Chancellor of Great Britain to affix the great seal to such bill of limitations as might be necessary to restrict the power of the future regent to be named by Parliament. This bill was accordingly brought forward, not without considerable opposition to its provisions, as well from private motives, as on forcible political grounds; and at length, happily for the public, arrested in its progress, by the providential recovery of his Majesty, in March 1789. It is observable, however, that no bill was ever afterwards introduced to guard against a future emergency of a similar nature: on the grounds, undoubtedly, of delicacy to a monarch universally beloved; in the hope of the improbability that such a circumstance should recur in future; and in the confidence of the omnipotence of Parliament, if necessarily called upon again. See Belsham's "Memoirs of George III.," sub. an. 1788-9: and the "Journals of the Lords and Commons."

Towards the end of King William's reign, the King and Parliament thought it necessary to exert their power of limiting and appointing the succession, in order to prevent the vacancy of the throne; which must have ensued upon their deaths, as no further provision was made at the revolution, than for the issue of Queen Mary, Queen Anne, and King William. It had been previously, by the statute 1 William and Mary, stat. 2, c. 2, enacted, that every person who should be reconciled to, or hold communion with, the see of Rome, who should profess the Popish religion, or who should marry a Papist, should be excluded, and for ever incapable to inherit, possess, or enjoy the crown; and that in such case the people should be absolved from their allegiance (to such person), and the crown should descend to such persons, being protestants, as would have inherited the same, in case the person so reconciled, holding communion, professing, or marrying, were naturally dead. To act, therefore, consistently with themselves, and, at the same time, pay as much regard to the old hereditary line as their former resolutions would admit, they turned their eyes on the Princess Sophia, Electress and Dutchess Dowager of Hanover: for, upon the impending extinction of the Protestant posterity of Charles I., the old law of legal descent directed them to recur to the descendants of James I.; and the Princess Sophia, being the youngest daughter of Elizabeth, Queen of Bohemia, who was the daughter of James I., was the nearest of the ancient blood-royal, who was not incapacitated by professing the Popish religion. On her, therefore, and the heirs of her body, being protestants, the remainder of the crown, expectant on the death of King William and Queen Anne, without issue, was settled by stat. 12 and 13 William III. c. 2. And at the same time it was enacted, that whosoever should hereafter come to the possession of the crown, should join in the communion of the Church of England, as by law established.

This is the last limitation of the crown that has been made by Parliament; and all the several actual limitations, from the time of Henry VI. to the present, (stated at large in 1 Comm. c. 3.) do clearly prove the power of the King and Parliament to new-model or alter the succession. And indeed it is now again made highly penal to dispute it; for by stat. 6 Anne, c. 7, it is enacted, that if any person maliciously, advisedly, and directly, shall maintain, by writing, or printing, that the kings of this realm, with the authority of Parliament, are not able to make laws to bind the crown and the descent thereof, he shall be guilty of high treason; or if he maintains the same only by preaching, teaching, or advised speaking, he shall incur the penalties of a præmunire. The Princess Sophia dying before Queen Anne, the inheritance, thus limited, descended on her son King George I.; and having taken effect in his person, from him it descended to his late Majesty King George II., and from him to his grandson and heir, our present gracious sovereign King George III. Formerly the common stock from which the heirs to the crown were derived, was King Egbert,

then William the Conqueror. In the time of James I., both stocks were united; and, by the abdication of James II., the common stock is the Princess Sophia, and the heirs of her body, being Protestant members of the Church of England, and married to such as are Protestants. This is therefore an hereditary monarchy, duly constituted between the extremes of divine hereditary, indefeasible right, and elective succession.

With respect to the royal family, the first branch considered in the law is the Queen, as to whom, see title QUEEN.

The Prince of Wales, or heir-apparent to the crown, and also his royal consort; and the Princess Royal, or eldest daughter of the King, are likewise peculiarly regarded by the laws. For, by statute 25 Edw. III. to compass or conspire the death of the former, or to violate the chastity of the latter, is as much high treason as to conspire the death of the king, or violate the chastity of the queen. See TREASON.

The heir-apparent to the crown is usually made Prince of Wales and Earl of Chester by special creation and investiture; but being the king's eldest son, he is, by inheritance, Duke of Cornwall, without any new creation.

The observations in Coke's Reports, however, as well as the words of the statute, it has been remarked, limit the dukedom of Cornwall to the first begotten (rather first born) son of a King of England, and to him only. But although from this it is manifest that a Duke of Cornwall must be the first begotten son of a king, yet it is not necessary that he should be born after his father's accession to the throne. The younger sons and daughters of the King and other branches of the royal family, were little regarded by the ancient law, except with regard to their state and precedence, which was directed by statute 31 Hen. VIII. c. 10; and it was agreed by all the judges, in 1718, that the care and approbation of the marriages are of the King's grand-children, as well as of the presumptive heir to the crown, belonged to the King, their grand father. And now, by statute Geo. III. c. 11, no descendant of the body of King George II. (other than the issue of princesses married into foreign countries) is capable of contracting matrimony, without the previous consent of the King signified under the Great Seal; and any marriage contracted without such consent, is void (a marriage accordingly, which had, in fact, taken place abroad against the provisions of this act, between one of the sons of George III. and an English lady, was dissolved in 1794, by sentence of the Ecclesiastical Court here); but it is provided by the act, that such of the said descendants as are above the age of twenty-five, may, after a twelve-month's notice given to the King's Privy Council, contract and solemnize marriage without the consent of the crown, unless both Houses of Parliament shall, before the expiration of the said year, expressly declare their disapprobation of such intended marriage. All persons solemnizing, assisting, or being present at any such prohibited marriage, shall incur the penalties of præmunire.

To assist the King in the discharge of his duties and maintenance of his dignity, and exercise of his prerogative, he has several counsels, as the PARLIAMENT, his PEERS, and his PRIVY COUNCIL, which see.

For law matter the judges are his council, as appears by statute 14 Edward III. c. 5, and elsewhere; and therefore when the King's Council is mentioned, it must be understood secundum subjectam materiam, as where a statute enacts a fine at the King's pleasure, it means the discretion of his judges.

It is in consideration of the duties incumbent on the King by our constitution, that his dignity and prerogative are established by the laws of the land; it being a maxim in the law, that protection and subjection are reciprocal. And these reciprocal duties are most probably what was meant by the convention parliament in 1688; when they declared that King James II. had broken the original contract between king and people. But, however, as the terms of that original contract were in some measure disputed, being alleged to exist principally in theory, and to be only deduceable by reason and the rules of natural law; in which deduction, different understandings might very considerably differ; it was, after the revolution, judged proper to declare these duties expressly, and to reduce that contract to a plain certainty. So that whatever doubts might be formerly raised about the existence of such an original contract, they must now entirely cease; especially with regard to every prince who hath reigned since the year 1688.

The principal duty of the King is to govern his people according to law. And this is not only consonant to the principles of

nature, reason, liberty, and society, but has always been esteemed an express part of the common law of England, even when prerogative was at the highest. But to obviate all doubts and difficulties concerning this matter, it is expressly declared by statute 12 and 13 William III. c. 2, That the laws of England are the birth-right of the people thereof; and all the kings and queens who shall ascend the throne of this realm, ought to administer the government of the same according to the said laws; and all their officers and ministers ought to serve them respectively, according to the same; and therefore all the laws and statutes of this realm for securing the established religion, and the rights and liberties of the people thereof, and all other laws and statutes of the same, now in force, are ratified and confirmed accordingly. See LIBERTIES.

As to the terms of the original contract between king and people; these it seems are now couched in the coronation oath, which, by statute 1 William and Mary, c. 6, is to be administered to every King and Queen, who shall succeed to the imperial crown of these realms, by one of the Archbishops or Bishops in the presence of all the people; who, on their parts, do reciprocally take the oath of allegiance to the crown.

As to the King's prerogatives, revenues, civil list, and authority, see the title PREROGATIVE.

This coronation oath is conceived in the following terms:

The Archbishop or Bishop shall say, will you solemnly promise and swear to govern the people of this kingdom of England, (*quere* Great Britain. See statute 5 Ann. c. 8, sect. 1. and this dictionary, title Scotland;) and the dominions thereto belonging, according to the statutes in parliament agreed on; and the laws and customs of the same? The King or Queen shall say, I solemnly promise so to do. Archbishop or Bishop, Will you to your power cause law and justice, in mercy, to be executed in all your judgments? King or Queen, I will. Archbishop or Bishop, Will you to the utmost of your power maintain the laws of God, the true profession of the gospel, and the protestant reformed religion established by the law? and will you preserve unto the bishops and the clergy of this realm, and to the churches committed to their charge, all such rights and privileges as by law do or shall appertain unto them or any of them? King or Queen, All this I promise to do. After this the King or Queen, laying his or her hand upon the Holy Gospels shall say, The things which I have here before promised, I will perform and keep, so help me God. And then shall kiss the book. It is also required, both by the Bill of Rights, 1 William and Mary, statute 2, c. 2, and the act of settlement, 12 and 13 William III. c. 2, that every King and Queen, of the age of twelve years, either at their coronation, or on the first day of the first parliament, upon the throne in the House of Peers (which shall first happen) shall repeat and subscribe the declaration against Popery, according to 30 Charles II. statute 2, c. 1.

The above is the form of the coronation oath, as it is now prescribed by our laws; the principal articles of which appear to be at least as ancient as the mirror of justices (c. 1. sect. 2.); and even as the time of Bracton. See l. 3. tr. 1. c. 9, the act of union, statute 5 Ann, c. 8, recites and confirms two preceding statutes; the one of the parliament of Scotland, the other of the parliament of England; which enact the former, that every King at his accession, shall take and subscribe an oath, to preserve the protestant religion, and presbyterian church government in Scotland; the latter, that at his coronation he shall take and subscribe a similar oath to preserve the settlement of the church of England, within England, Ireland, Wales, and Berwick, and the territories thereunto belonging.

KING *at arms*, or *of arms*, an officer who directs the heralds, presides at their chapters, and has the jurisdiction of armory. There are three kings of arms in England, namely, Garter, Clarencieux, and Norroy.

KING, *Garter principal, at arms.* He, among other privileges, marshals the solemnities at the funerals of the prime nobility, and carries the garter to kings and princes beyond sea, being joined in commission with some peer of the kingdom. See GARTER.

KING, *Clarencieux, at arms.* This King (who is next to Garter) is called Clarencieux, from the Duke of Clarence to whom he first belonged; for Lionel, third son of King Edward III. marrying the daughter and heir to the Earl of Ulster in Ireland, with her had the honour of Clare in the county of Thomond, whereupon he was afterwards created Duke of Clarence, or the territory about Clare; which dukedom escheating to Edward IV. by the death of his brother George Duke of Clarence, (who

was secretly murdered in the Tower of London) he made the Herald, who properly belonged to that Duke, a King of Arms, and named him Clarencieux.

His office is to marshal and dispose of the funerals of all the lesser nobility, as Baronets, Knights of the Bath, Knights Batchelors, Esquires, and Gentlemen, on the south side of the river Trent, and therefore is sometimes called Surroy, or South-Roy.

KING, *Norroy, at arms.* The office of this King, (who is called Norroy or North-Roy) is to do the like on all the north side of Trent, as Clarencieux on the south; and these being both provincial Kings of Arms, have the whole kingdom of England divided between them; and are created by letters patents, a book, a sword, &c. as Garter, and with almost the same ceremony.

Note. That in the sixth of Edward VI. Bartholomew Butler, York Herald, was created Ulster King of Arms in Ireland, at which time Philip Butler was made Athlone Pursuivant of Arms there; and upon their creation, a warrant was issued to Sir Ralph Sadler, Knight of the King's Wardrobe, to deliver to the said Bartholomew Butler, alias Ulster King of Arms of Ireland, one coat of blue and crimson velvet, embroidered with gold and silver upon the same with the King's Arms; and to the said Philip Butler, Athlone Pursuivant, one coat of sarsenet of the King's colours, with the arms laid on with gold and purple.

KING *at arms, Lyon,* for Scotland, is the second king at arms for Great Britain; he is invested and solemnly crowned. He publishes the king's proclamations, marshals funerals, reverses arms, appoints messengers at arms, &c. See COLLEGE *of heralds.*

KING's *Bench.* The King's Bench is the supreme court of common law in the kingdom; and is so called, because the King used to sit there in person: it consists of a chief justice, and three puisne justices, who are by their office the sovereign conservators of the peace, and supreme coroners of the land. This court has a peculiar jurisdiction, not only over all capital offences, but also over all other misdemeanors of a public nature, tending either to a breach of the peace, or to oppression, or faction, or any manner of misgovernment. It has a discretionary power of inflicting exemplary punishment on offenders, either by fine, imprisonment, or other infamous punishment, as the nature of the crime, considered in all its circumstances, shall require.

The jurisdiction of this court is so transcendant, that it keeps all inferior jurisdictions within the bounds of their authority; and it may either remove their proceedings to be determined here, or prohibit their progress below: it superintends all civil corporations in the kingdom; commands magistrates and others to do what their duty requires by mandamus, in every case where there is no specific remedy; protects the liberty of the subject, by speedy and summary interposition; and takes cognizance both of criminal and civil causes, the former in what is called the crown side, or crown office, the latter in the plea side of the court. This court has cognizance on the plea side, of all actions of trespass, or other injury alleged to be committed *vi et armis*; of actions for forgery of deeds, maintenance, conspiracy, deceit; and actions on the case which allege any falsity or fraud. In proceedings in this court the defendant is arrested for a supposed trespass, which in reality he has never committed, and being thus in the custody of the marshal of this court, the plaintiff is at liberty to proceed against him for any other personal injury; which surmise of being in the custody of the marshal the defendant is not at liberty to dispute. This court is likewise a court of appeal, into which may be removed, by writ of error, all determinations of the court of Common Pleas, and of all inferior courts of record in England. It is now usually held at Westminster; but was formerly attendant upon the King's person, and original writs are returnable "wheresoever we (the King) shall then be in England."

KNAPSACK; a rough leather or canvass bag, which is strapped to an infantry soldier's back when he marches, and which contains his necessaries. Square knapsacks are supposed to be most convenient. They should be made with a division to hold the shoes, blacking-balls, and brushes, separate from the linen. White goat-skins are sometimes used; but we do not conceive them to be equal to the painted canvass ones. Soldiers in the British service are put under stoppages for the payment of their knapsack, which after six years become their property. Knapsack is said to have been originally so called from the circumstance of a soldier making use of a sack which had been full of corn, &c. In those days there were no roads, and every thing was carried on packhorses. When the soldiers reposed, they hung up the empty sacks, and slept in them. The word should be napsack, from

napping, &c. to slumber. The army was supplied by packhorses, and all things were in sacks, so that every soldier had his sack. Such is the account given by a very worthy and respectable friend; but we are inclined to think that knapsack comes from the Saxon word *snapsack*, a bag to carry food. See James's Dictionary.

KNAUTIA, in botany, so named from Christopher Knaut, a genus of the Tetrandria Monogynia class and order. Natural order of Aggregatæ. Dipsaceæ, Jussieu. Essential character: calyx common oblong, simple, five to ten-flowered; corollets irregular; receptacle naked. There are four species, mostly natives of the Levant.

KNEE. See ANATOMY.

KNEE, a crooked piece of timber, having two branches or arms, and generally used to connect the beams of a ship with her sides or timbers. The branches of the knees form an angle of greater or smaller extent, according to the mutual situation of the pieces which they are designed to unite. One branch is securely bolted to one of the deck-beams, and the other in the same manner strongly attached to a corresponding timber in the ship's side. Besides the great utility of knees in connecting the beams and timbers into one compact frame, they contribute greatly to the strength and solidity of the ship, in the different parts of her frame to which they are bolted, and thereby enable her with great firmness to resist the effects of a turbulent sea.

KNIGHT, in military concerns. This word is an anglicism of the German word *knecht*, signifying a person possessing the talents and bravery of a soldier, and rewarded for some particular acts of courage and address by the sovereign.

Knights, or Equites, in the Roman art of war were originally instituted by Romulus, who selected three hundred athletic young men from the best families of the class of Patricians, and had them trained to serve their country on horseback. This politic mode of securing the services of the most important part of the community to the existing government was improved upon by Servius Tullus, after the introduction of the census, who admitted all persons worth four hundred sestertia into the noble order of the Equites, whose conduct and morals were irreproachable, a precaution highly honourable to the Roman character, and acted upon rigidly by monarchs, consuls and censors. Having ascertained this point, by regular scrutiny, the name of the individual approved was enrolled with those of the order, a ring was presented to him, as a pledge of his acceptance into it, and he received a horse provided at the public expense; thus instituted a knight, he was required and expected to appear at a moment's notice ready to execute to the utmost of his ability those services which the state demanded.

There were three distinct and solemn acts performed by the government calculated to impress the members with the necessity of adhering to their compact with their country; those were termed the Probatio, the Transvectio, and the Recensio. The first may be considered an annual examination as to the moral conduct of the Equites, the state of their arms, their horses, and their own health; the second, an universal assemblage of the knights in the forum, is thus described by Dyonisius: "The sacrifices being finished, all those who are allowed horses at the expense of the state, ride along in order, as if returning from a battle, being habited in the Togæ Palmatæ, or the Trabæ, and crowned with wreaths of olive. The procession begins at the temple of Mars, without the walls, and is carried on through all the eminent parts of the city, particularly the Forum, and the temple of Castor and Pollux. The number sometimes reaches to five thousand; every man bearing the gifts and ornaments received as a reward of his valour from the general. A most glorious sight, and worthy of the Roman grandeur." According to Plutarch this honourable body of soldiers, and the rest of the army engaged in battle with the Latins, about the two hundred and fifty-seventh year of the city, were personally assisted by Castor and Pollux, who afterwards appeared in Rome mounted on horses foaming with exertion, near the fountain where their temple was subsequently erected; grateful for their supernatural aid, the Romans established the Transvectio in honour of the deified brothers.

The Recensio resembled the Probatio in some degree, except that more importance was attached to the former, as it was an universal muster of the whole people including the Equites, to answer the useful military purposes of ascertaining the then state of discipline of men bearing arms, enrolling of new names, and expunging

others. The ceremony occurred every lustrum under the superintendence of the censors.

When the Equites had accomplished the term for which their services were required it was the established custom to lead their horses to the place where the two censors were seated in the Forum to whom they related the circumstances attending their various campaigns, and under whom they served; they were then discharged either with honour or disgrace as their conduct was approved or considered disgraceful.

It is generally admitted that it is by no means correct to suppose that all the Roman soldiers mounted on horses were knights. Sigonius, and others, made a distinction in the cavalry between those who served *equo publico*, and those who served *equo privato*; "the former" says Kennet, "they allow to have been of the order of knights, the latter not. They demonstrate from the course of history, that from the beginning of the Roman state till the time of Marius, no other horse entered the legions but the true and proper knights, except in the midst of public confusion, when order and discipline were neglected."

Like all other institutions this order began to degenerate, the life and soul of honour which supported it died and faded away, leaving a mere shadow of its pristine importance, indolence and avarice tempted individuals from the pursuit of military fame to the more innocent, and, perhaps, more laudable occupations of agriculture, and to partake of the emoluments to be derived from places of trust under the government; those who retained sufficient vigour of mind to consider themselves as still belonging to the order, obtained commands, and the mass of the cavalry was at length composed of foreign mercenaries. Fully sensible of the degraded state of the Equites, who wished to receive the honours due to them when deserving of honour, and a horse from their country, when that country no longer was remunerated by their services, subsequent princes deprived them of the horse, but suffered them to retain the golden ring.

Knights' *service*, this species of servitude was the consequence of the weakness and decay of the feodal system thoughout Europe, and was invented as a remedy. Fiefs, which had previously been held for long terms of years, were made hereditary, and the holder was compelled to afford, without exception or a possibility of denial, as many soldiers to be maintained by the produce of the lands, as the lord proprietor was disposed to think proper, this became the tenure of knights' service; but a single soldier derived as the service of a certain portion of land was termed a knights' fee, and an estate furnishing a number of men trained for the field was said to contain an equal number of knights' fees; this system, extending in every direction, rendered each nation acting under it formidable and dangerous to the adjoining, as numerous armies might be assembled at a very short notice, and much blood spilt before reason had time to subdue sudden resentment, besides the means of oppression it afforded to men of large possessions. The armies thus assembled were commanded by the monarch, the nobles acted as officers, and all the varieties of vassals were considered and sorted as private soldiers. Exclusive of the tyranny of exacting personal service, the holders of knights' tenures were subject to all the ancient hardships of the old system, under the name of incidents, for chief aid, escheat, wardship and marriage, and they were compelled to bind themselves to their oppressor by oaths of homage and fealty.

It is supposed that knights' service had been universally established in Europe by the year 987; if so, there cannot be the least doubt that it was introduced into England by William of Normandy obtaining the absolute right of disposing of the territory of the conquered chiefs of this country; the obvious policy of the monarch was the distribution of it to those persons who had adopted his fortunes; and in what way could he more firmly bind them to his future support than by compelling them to furnish men by the prevailing tenure?

Pursuing this policy, the old tenants received fresh grants, and were thus secured by the subtle king from attempting to wrest his conquests from him; indeed it has been asserted, that the system was generally approved, as but few of the Anglo-Saxon fiefs were hereditary. The knights were bound to appear completely armed with a lance, sword, shield and helmet, and well mounted at the shortest notice from their superiors, and to remain in the field forty days at the expence of the chiefs of their fees. At length similar causes to those which have been mentioned to have actuated the Roman equites, induced the English

knights to commute their personal services for fines, and hence arose the system of taxation.

An act of parliament was passed in the reign of Edward II. which required all persons possessed of 20*l.* per annum to appear and receive the honour of knighthood from the king. This cause and others operated to produce such numbers of knights throughout Europe, that it became necessary to invent different orders of knighthood, to render some of the members at least of importance in the estimation of the community.

Charles I. strangely infatuated and mistaken in his conduct, adopted the obsolete practice of his ancient predecessors, and issued "a warrant to the sheriffs in 1626, to summons all persons that had for three years past held 40*l.* per annum, or more, of lands or revenues in their own hands, or the hands of feoffees, and are not yet knights, to come before his majesty by the thirty-first of January, to receive the order of knighthood."

January 28, 1630, the king issued a commission to the Lord Keeper, Lord High Treasurer, &c. to compound with those who had made themselves liable to forfeiture, by neglecting to receive knighthood, according to act of parliament; alluding to the act of Edward II. This commission, absurd and oppressive beyond modern conception or endurance, produced above one hundred thousand pounds to the royal treasury, but did the king infinite injury in the opinion of his subjects, who had long considered the *statutum de Militibus* a nullity, and which was afterwards repealed by parliament. Charles rather alarmed at the general expression of abhorrence excited by his conduct, published "a proclamation for the ease of his subjects, in making their compositions for not receiving the order of knighthood according to law, dated in the preceding July;" this however was nothing more than an attempt to soften the displeasure of the public, and failed of its effect. The ancient ceremony of making a knight consisted of giving the party a blow on the ear, and striking him on the shoulder with a naked sword, after which he had a sword girded round him, and spurs attached to his heels, and being otherwise completely armed as a knight, he was conducted in solemn procession to hear the offices of religion.

Since the above period knighthood has been considered a proper method of rewarding persons who have rendered slight services to the state, but the very frequent opportunities afforded of conferring the honour, has operated in producing the little estimation in which it is held, and from which there is no present prospect of its recovering. The observations just made must not at the same time be supposed to apply to the more honourable orders which have already been noticed under the article of Knights of the Bath, and Knights of the Garter, exclusive of the numerous foreign orders, which have existed, and do still exist, in different parts of Europe.

Knights' *templars.* This order has been suppressed for many centuries, but as they were once considered a very powerful body, and had large possessions in England, of which the extensive and valuable domain, still known by the name of the Temple, in London, was a part, a slight sketch of their history appears to be necessary.

The order was instituted in the year 1118, for the actual defence of the places rendered sacred by the residence and acts of Jesus Christ, in the city of Jerusalem and its neighbourhood; and the house which they occupied, being purposely situated near the temple there, they acquired the name of Templars; and, from the same cause, their principal mansions throughout Europe were called temples. The Council of Troyes confirmed and established them in the rule of St. Bernard, in the year 1127, and the brethren were divided into two classes, knights, and servitors. Saladine having invaded and conquered the territories they had bound themselves to protect, they were compelled to leave the Holy Land, and to establish the order where they found a kind reception, which was almost in every part of the world then under the influence of the Christian religion, as they had double claims on the pious, proceeding from their peculiar profession and sufferings for the cause of the Saviour. During the period they depended upon the alms and bounty of the public, they were distinguished for their meek and meritorious conduct, which operated so greatly in their favour, that gifts flowed into their treasuries from the sovereign to the peasant, in every country where a house of knights' templars existed. Matthew Paris asserts, the order possessed 9,000 rich convents; and other writers add, that they had 16,000 lordships, 'with subordinate'

governors distributed in every part of Europe.

Under these prosperous circumstances, they became inflated by pride, and insolence usurped the place of meekness: relying upon their presumed consequence, they did not attempt to conciliate where they had offended; nor did they seem to suspect the hatred they had generated, till it was too late to resist or retract; such is the general tenor of the accounts given of the conduct of the knights templars by historians; but although those may be founded in fact, it is not to be supposed, that pride alone caused the dissolution of the order; avarice, on the part of their oppressors, was the grand agent, and the riches of the knights the temptation to plunder them. Some of the members resident in Paris, were indiscreet or wicked enough to cause a riot in the streets of that city, Philip the Fair, then on the throne of France, seizing on this opportunity, determined to make use of it to accomplish the total ruin of the order; he therefore procured the evidence of many infamous brethren, either by bribery or other means, who charged the knights generally with the most shocking enormities: acting upon this base testimony, the king ordered the arrest of every templar in his dominions, abolished the order, and even caused fifty-seven of them to be burned to death: the Pope, influenced by the same spirit of injustice, and probably invited to partake of the plunder, called a general council at Vienna, by which the order was laid under an interdict.

Philip immediately communicated his proceedings to our monarch, Edward II., who returned an answer, dated October 30, 1307, in which he expressed great astonishment at the accounts received of the abominable heresy of the Templars, and declared his intention of obtaining further information through the Seneschal of Agen. Clement directed a brief to Edward, dated the 30th of November following, explaining the conduct of Philip, and asserting, that the Grand Master had confessed, that the knights, at their admission into the order, denied the divinity of Jesus Christ, spit upon the crucifix, and worshipped an idol in their chapters; adding other charges which appear equally wicked and incredible; but calculated to exculpate Philip, whose example the holy father recommended Edward to imitate in his own dominions. Edward seems to have acted, on this delicate occasion, with some degree of wisdom and resolution; but he was deficient in that firm spirit which governed Henry VIII; this is proved by a circular letter from him, directed to the Kings of Castille, Arragon, Portugal, and Sicily, dated December 4th, 1307; and another to the Pope, in each of which he expressed his disbelief of the accusations against the Templars, and mentioned a priest who had endeavoured to confirm them to him, but ineffectually, as he was convinced the public agreed with himself in approving their manners and conduct; and yet, such is the weakness and instability of human nature, this very king was prevailed upon to issue an order, addressed to the sheriffs, for the apprehending of every Templar in the kingdom, upon the feast of the Epiphany, 1308.

The Pope, fearful of the wavering disposition of the Monarch, sent another brief into England, repeating all the old charges, and producing others, which he addressed to the Archbishop of Canterbury, and his suffragans, at the same time, informing them, he had appointed three cardinals, four English bishops, and several of the French clergy, to manage the process to be instituted here against the unfortunate order. After the arrival of the commissioners alluded to, Edward had the good sense and precaution to command the invariable attendance of the British part of it on every day the business was prosecuted, by a letter directed to the Bishop of Lincoln, dated September 13th, 1309: thus shewing, that had he dared to save the Templars he would have done so without hesitation; but the King and the nation were equally alarmed at the consequences of anathemas and interdicts, and were compelled to acquiesce in the dictates of the commissioners, who sentenced the knights to eternal separation, and the loss of all their territories in Great Britain. To the everlasting honour of Edward, he rejected the cruel example of the King of France, and, instead of burning the knights, he merely confined them in different monasteries, where they resided, secure and comfortable, till their deaths. The estates of the Knights Templars having been confiscated, the King very naturally concluded that he was entitled to them, and consequently proceeded to sell and give them away; the Papal see, however, thought otherwise, and a fresh bull arrived, demanding them for the knights of the order of St. John of Jerusalem in England; as the same causes existed for compliance with this new mandate,

which induced the suppression, the property in question was conveyed to the

KNIGHTS *of St. John of Jerusalem.* The order of St. John originated from the establishment of an hospital at Jerusalem, in the year 1048, by certain Italian merchants, for the reception of pilgrims and travellers, which they dedicated to the Baptist. The subsequent conquest of Jerusalem, by Godfrey of Boulogne, who wrested it from the Turks, was of infinite service to the Hospital, which flourished in the same proportion with the facility thus afforded for visiting the holy city. Raymond, rector of the brethren in its then state, being of an active and military turn, formed the plan of converting them into knights, captains, and servants; he marshalled them into bands, invented banners, and led them on against the Turks, as knights of the order of St. John of Jerusalem; they fought with great bravery; but the inferiority of their numbers occasioned frequent defeats, and they were at length compelled to give up their possessions to the conqueror Saladine: after a continued series of toils and misfortunes, and a constancy in the cause of religion which did them great honour, they were finally expelled from the Holy Land, in the year 1292.

The master and brethren fled to the island of Cyprus, where they employed their leisure in framing statutes for the government of the order; but recurring to their former military pursuits, they attacked Rhodes in 1308, which, with seven other islands, soon fell into their possession; they then assumed the addition of Rhodes to their previous titles, there they flourished for a very considerable length of time, and resisted the Turks with equal bravery and skill; but Sultan Soliman, having determined at all events to dislodge them, he assembled an army of 300,000 men, with which he invaded the island, and, after six months incessant fatigue and excessive loss, he succeeded in expelling them. The Emperor Charles V. gave them Malta at this critical æra, to which island the knights retired in 1523. There they underwent repeated invasions from the Turks, and obtained the admiration of all nations for their invincible courage and address, in repelling their attacks. The Knights of Malta, as they were now called, might have remained for centuries to come in quiet possession of their island, had they not been disturbed by a power they had little reason to dread till very lately: their surrender of it to the arms of France, has been the means of placing it in the possession of England, and the order may be considered as almost extinct.

Jordan Brisset introduced the order into England, by founding the Priory of St. John, at Clerkenwell, where it flourished till the general dissolution of religious houses by Henry VIII. It will be sufficient to add, from Malcolm's "Londinium," "Camden says, that the priors were held equal in rank to the first barons of the realm; and their riches certainly enabled them to support their splendour of living. Such was their power and influence, that Edward III. thought it necessary, in the fortieth year of his reign, to appoint Richard de Everton visitor of the hospitals of this order, in England and Ireland, to repress their insolence, and to enforce propriety of conduct; which appointment was repeated five years after by the same King."

KNIGHT originally signified a servant; but there is now but one instance where it is taken in that sense, and that is knight of a shire, who properly serves in parliament for such a county; but in all other instances it signifies one who bears arms; who for his virtue and martial prowess is by the King, or one having his authority, exalted above the rank of gentleman, to an higher step of dignity. They were called *milites*, because they formed a part of the royal army, by virtue of their feudal tenures; one condition of which was, that every one who held a knight's fee, immediately under the crown (which in the reign of Edward II. amounted to 20*l.* per annum,) was obliged to be knighted. He was also to attend the King in his wars, or fine for his non-compliance. The execution of this prerogative, as an expedient to raise money in the reign of Charles I., gave great offence, though then warranted by law, and the recent example of Queen Elizabeth: it was, therefore, abolished by 16 Charles I. c. 20. Considerable fees accrued to the King on the performance of the ceremony. King Edward VI. and Queen Elizabeth had appointed commissioners to compound with the persons who had lands to the amount of 40*l* a year, and who declined the honour and expense of knighthood.

KNIGHTS *banneret.* These knights are only made in the time of war. They are ranked next after the barons; and their precedence before the younger sons of viscounts was confirmed by James I. in the

tenth year of his reign. But to entitle them to this rank they must be created by the King in person in the field, under the royal banners, in time of open war; otherwise they rank after baronets.

KNIGHT *service*, a tenure, where several lands were held of the King, which draws after it homage and service in war, escuage, ward, marriage, &c. but is taken away by statute 12 Charles II. c. 24.

KNOT, means the divisions of the log-line used at sea. These are usually seven fathoms, or forty-two feet; they ought to be fifty feet, and then as many knots as the log-line runs out in half a minute, so many miles does the ship sail in an hour, supposing her to keep going at an equal rate.

KNOTS *of a rope*, among seamen, are distinguished into three kinds, *viz.* whole-knot, that made so with the lays of a rope that it cannot slip, serving for sheets, tacks, and stoppers: bow-link knot, that so firmly made, and fastened to the cringles of the sails, that they must break or the sail split before it slips: and sheep-shank-knot, that made by shortening a rope without cutting it, which may be presently loosened, and the rope not the worse for it.

KNOWLEDGE, is defined by Mr. Locke, to be the perception of the connection and agreement, or disagreement and repugnancy of our ideas.

KNOXIA, in botany, so called from Robert Knox, a genus of the Tetrandria Monogynia class and order. Natural order of Stellatæ. Rubiaceæ, Jussieu. Essential character: corolla one-petalled, funnel-form; seeds two, grooved; calyx one, leaflet larger. There is only one species, *viz.* K. zeylanica, a native of Ceylon.

KOELREUTERIA, in botany, so named in honour of Joseph Gottlieb Koelreuter, a genus of the Polygamia Monoecia class and order. Natural order of Trihilatæ. Sapindi, Jussieu. Essential character: calyx five-leaved; petals four; nectary double, four scalelets, and three glands; stamens eight, fixed to a column; germ three-sided, fixed to the same column; capsule three-celled, with two cells in each cell. There is but one species, *viz.* K. paullinoides; this is a tree, with an arboreous, upright, trunk, about six feet in height; branches scattered, spreading, when young having dotted glands scattered over them; buds from the axils of the leaves, resinous, cone-shaped with imbricate scales; peduncles, terminating, scattered, spreading, branched into many pedicles; flowers panicled, three or more on each pedicle. According to L'Heritier it is a polygamous tree, and a native of China.

KOENIGIA, in botany, so named in honour of John Gerard Koenig, M. D. of Courland, who first found this plant in Iceland. It is a genus of the Triandria Trigynia class and order. Natural order of Holoraceæ. Polygoneæ, Jussieu. Essential character: calyx three-leaved; corolla none; seed one, ovate, naked. There is but one species, *viz.* K. islandica.

KOS, in Jewish antiquity, a measure of capacity, containing about four cubic inches: this was the cup of blessing, out of which they drank when they gave thanks after solemn meals, like that of the passover.

KRAMERIA, in botany, so named in memory of John George, Henry, and William Henry Kramer, botanists, a genus of the Tetrandria Monogynia class and order. Essential character: calyx none; corolla four-petalled; nectary upper three-parted, lower two-leaved; berry dry, echinated, one-seeded. There is but one species, *viz.* K. ixina, this is a shrub with lanceolate leaves; flowers alternate, in terminating racemes. It was found in South America by Loefling.

KUHNIA, in botany, so called from Adam Kuhnius, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: flowers floscular; calyx imbricate, oblong, cylindrical; down plumose; receptacle naked; style deeply bifid; stigmas club-shaped; anthers distinct. There is but one species, *viz.* K. eupatorioides, a native of Pensylvania.

KURTUS, in natural history, a genus of fishes of the order Jugulares. Generic character: body carinated above and below, and broad; back highly elevated; gill membrane, with two rays. This consists, as far as it is known, of only a single species. It inhabits the seas of India, and is supposed to live on insects, shell fish, and particularly young crabs. Its length is about ten inches, and its breadth four. Its colour, on the whole body, is that of silver foil, and its back is tinged with gold, and marked on its ridge with several black spots. For a representation of the kurtus, see Pisces, Plate V. fig. 1.

KYANITE, or CYANITE, in mineralogy, a species of the talc genus: its principal

colour blue, though it occurs also white and grey; some specimens are entirely blue, others are only spotted, striped, or flamed with it. Externally and internally its lustre is shining and splendent, and completely pearly. It occurs in wedge-shaped concretions, which are often very promiscuous, and then pass into large and coarse grained distinct concretions. It feels greasy; is easily frangible, and the specific gravity is from 3.5 to 3.6. It is infusible before the blow-pipe, and is found to consist of

Silica	29. 2
Alumina	55. 0
Lime	2.25
Magnesia	2. 0
Oxide of iron	6.65
Water and loss	4. 9
	100.00

It is peculiar to the primitive mountains, where it occurs imbedded in talc slate, and mica slate, accompanied with grenatite. It is found in many parts of Europe. It is reckoned the link which connects talc with actynolite and trenolite.

KYLLINGIA, in botany, a genus of the Triandria Monogynia class and order. Natural order of Gramina. Cyperoideæ, Jussieu. Essential character: ament ovate or oblong, imbricate; flowers with a bivalve calyx and corolla. There are seven species, natives of the East and West Indies.

L.

L, Or l, the eleventh letter and eighth consonant of our alphabet. It is a semi-vowel, formed in the voice by intercepting the breath between the tip of the tongue and the fore-part of the palate, with the mouth open.

There is something of aspiration in its sound, and therefore the Welsh usually double it, or add an *h* to it; as in *llan*, or *lhan*, a temple.

In English words of one syllable, it is usually doubled at the end; as in *all*, *wall*, *mill*, &c. but in words of more syllables than one, it is only single at the end; as in *fortel*, *proportional*, &c. It may be placed after most of the consonants, as in *blue*, *clear*, *flame*, &c. but before none of them. As a numeral letter, L denotes 50; and with a dash over it, thus, L̄, 50,000.

LA, in music, the syllable by which Guido denotes the last sound of each hexachord: if it begins in C, it answers to our A; if in G, to E; and if in F, to D.

LABDANUM, or LADANUM, is a resin obtained from the surface of the crystus creticus, a shrub which grows in Syria and the Grecian islands. It is collected while moist, by drawing over it a kind of rake, with thongs fixed to it, from which it is afterwards scraped. When it is very good it is black, soft, and has a fragrant odour and a bitterish taste. Water dissolves about a twelfth part of it, and the matter taken up possesses gummy properties. When distilled with water, a small quantity of volatile oil arises. Alcohol may also be impregnated with a taste and odour of labdanum.

LABATIA, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Guajacanæ, Jussieu. Essential character: calyx four-leaved, inferior; corolla subcampanulate, four-cleft, with two minute segments in the division of the corolla; capsule four-celled; seeds solitary. There are two species, viz. L. sessiliflora, which is a native of Hispaniola; and L. guianensis is a tree exceeding forty feet in height, and three in diameter; the bark is of a russet colour; the wood is hard and white; the largest leaves are eight inches in length, and three in width; flowers axillary, or on the branches in pairs or threes, each on its pedicel; corolla greenish. It is called by the natives of Guiana, pourama pouteri.

LABEL, in heraldry, a fillet usually placed in the middle along the chief of the coat, without touching its extremities. Its breadth ought to be a ninth part of the chief. It is adorned with pendants; and when there are above three of these, the number must be specified in blazoning. This is a kind of addition to the arms of a second brother, to distinguish him from the first, and is esteemed the most honourable of all differences.

LABEL, in law, a narrow slip of parchment hanging from a deed, writ, or other writing, in order to hold the appending seal.

LABEL *of a circumferentor*, a long thin brass ruler, with a sight at one end, and a centre hole at the other; chiefly used with a tangent line, to take altitudes.

LABIAL *letters*, those pronounced chiefly by means of the lips. See LETTER.

LABIATED *flowers*, monopetalous flowers, consisting of a narrow tube, with a wide mouth, divided into two or more lips. See BOTANY.

LABORATORY. A laboratory properly fitted up with apparatus, is essentially necessary to a chemist whose objects lead him to make researches, experiments, and processes, upon all the different scales of operation. That great interest which the important science of chemistry has excited in all ranks of men, within the last thirty years, has rendered it easy to procure very complete sets of apparatus; which at least in the metropolis may be collected in a short time, by those who like Boyle, Cavendish, Lavoisier, and other great men, are in possession of ample means. But on the other hand, it is proper to remark, that many of our greatest discoverers, such as Scheele, Priestley, Berthollet, Wollaston, Dalton, Crawford, and a numerous set of eminent men, have from choice, or from motives of prudence, made use of very simple, cheap, and small sized apparatus. It is undoubtedly true that many operations can only be performed upon a scale of considerable magnitude, and that many facts of great value display themselves upon the extensive theatre of nature or in large manufactories, which are either not seen, or require uncommon discernment to perceive them in the contracted space, and during the short time employed in the performance of a philosophical experiment. But it is no less true that experiments upon a small scale do likewise possess their exclusive advantages. During the fusion and combination of substances, in the whole no larger than a pepper-corn before the blow-pipe, the effects take place with rapidity, and many of them, such as the escape of gas by effervescence, the changes of colour, and transparency by differences in the heat applied, the manner of acquiring the solid state, &c. which cannot be seen in the furnace, are in the course of a few seconds remarked and ascertained. The saving of time is also an object of leading importance. The same considerations are likewise applicable to processes of fusion, or other applications of heat in a small vessel, such as a tobacco-pipe, placed in a common fire, urged by the bellows if necessary. Humid operations may also be very advantageously conducted by single drops of liquid, and small particles of solid bodies laid upon a glass plate, or in the metallic spoon, and the lamp for distillations, and other works even upon a scale of some magnitude, has long been a favourite instrument with chemists. These will come under our notice as we proceed.

Under our article CHEMISTRY we have given a concise sketch or enumeration of the practical treatment of bodies, which leads us to point out the instruments in this place.

For the mechanical division of bodies it is requisite the chemist should have the usual instruments for cutting, breaking, rasping, filing, or shaving. One or more mortars for pounding; the best are made of hard pottery. A stone and muller for a levigating. A pair of rollers for laminating metals. A forge for many, or most of the purposes in which the blast heat of a small fire is required; and various other tools and implements, not peculiar to chemistry.

Messrs. Aikin, in their Chemical Dictionary, give the following list of implements and materials; which, upon deliberate examination, we highly approve:

A gazometer, with the connecting tubes, blow pipe, &c.

A bladder, or silk bag, with stop cock, fitting the above.

A pneumatic water trough.

A copper still with worm tub, the still fitting into the top of the Black's furnace.

A blow-pipe, with spoon, &c.

Lamps—an Argand, and others of common construction, for oil and alcohol.

An apparatus for drying precipitates by steam.

Scales and weights.

Large and small iron stands for retorts, &c.

Mortars—one of hard steel, one of bell-metal, and one or two of Wedgwood ware.

A silver crucible and spatula.

A platina crucible and spatula.

A jointed iron tube for conveying gases.

The following articles in glass:

Retorts of different sizes, plain and stoppered, and long necked for gases.

Receivers to fit the above, plain and stoppered, with or without an adopter.

Plain jars for gases, different sizes.

Lipped jars for mixtures, precipitates, &c.

A graduated eudiometer jar.

Bell receivers, two or three sizes.

Proof bottles.

Capsules, or small evaporating caps.

Water glasses (such as are used at table) which are very convenient for gentle evaporations.

Florence flasks.

Matrasses—two or three very small, and others of common size, round and flat bottomed.

Funnels—ribbed, and one plain with a very long neck for charging retorts.

Wine glasses—common or lipped.

Watch glasses, for evaporating minute quantities at a very gentle heat.

Common decanters.

A bottle for specific gravity of fluids.

Phials of all sizes, plain and with ground stoppers.

Plain glass tube of various thickness and bore, out of which may easily be made,

Syphon tubes,

Bent tubes for gases,

Capillary tubes, for dropping liquids, and various other useful articles.

A gas-saturating apparatus.

A Woulfe's apparatus.

A tube of safety, separate.

A barometer.

Thermometers—common, and with the bulb naked, to dip into liquors.

The following in earthen-ware.

Crucibles—Hessian, common, and black-lead, of different sizes and shapes, with stands and covers.

Retorts.

Retort stands.

Cupels.

Wedgwood evaporating dishes—a set.

White basons, with lips, different sizes.

Common white cups and saucers.

Tubes—straight and bent.

Porcelain spoons.

Ditto rods, for stirring corrosive fluids.

Several stone-ware jars, with tin covers, for holding salts, &c.

Also the following sundries:

Wire—different sizes and kinds, viz. iron, copper, brass, silver, and platina.

Gold, silver, and brass leaf—tinfoil.

Wooden tripod stands for receivers, &c.

Fire tongs—various shapes.

Steel spatula and pallet knives.

Iron ladles.

Diamond for scratching glass.

Files—flat, three-cornered, and rat-tailed.

Hammers.

A vice and anvil.

Pincers.

Shears and scissars.

A magnet.

Sieves.

Filtering paper.

Corks.

Bladders—spirit varnish—sponge—tow—linen—flannel.

Windsor and common bricks—tiles—sand

Lutes of various kinds.

For more extensive and delicate researches it is also necessary to have

A mercurial pneumatic trough.

A mercurial gazometer.

A burning lens of considerable power.

An electrical apparatus.

A Galvanic apparatus.

A detonating jar.

A glass or silver alembic.

The fuel to be employed has been already mentioned under that article, and a supply should be kept near at hand, broken down ready for use.

With regard to the different substances or re-agents to be kept, the chemist will, of course, wish to have a specimen of all the simple or individual substances, such as the acids, earths, metals, &c. but the simple and compound substances which are of general use, ought also to stand on the shelves.

For many purposes the ordinary degree of purity in which these substances are obtained by the common processes are sufficient; so, for example, the small quantity of potash in common sulphuric acid, and of iron in common muriatic acid, seldom interferes with any of the uses to which those re-agents are applied; but it is also necessary frequently to have them in the utmost purity when employed as tests for delicate purposes. The chemist will therefore find it of advantage to reserve a

separate set of a few of the most necessary re-agents in their utmost purity, and if only employed when absolutely required, a very moderate quantity will suffice. In the subjoined list we have distinguished by the word pure those substances which require particular pains to be obtained absolutely pure. Mixtures of each of the stronger acids and water in two or three different and known proportions should also be kept.

N. B. The letter D implies that the dry substance should be kept, and S, that it should be in solution.

Sulphuric acid, pure.
——— common.
Nitric acid, pure and boiled.
——— common and boiled.
——— fuming.
Muriatic acid, pure.
——— common.
Oxymuriatic acid. This should be kept in the dark.
Phosphoric acid, pure, from phosphorus S.
Acetic acid.
Distilled vinegar.
——— constrated by frost.
Oxalic acid. S.
Tartareous acid. S.
Sulphate of Potash. D. and S.
——— Soda. D. and S.
——— Barytes. D.
——— Alumina. S.
——— Strontian. D.
Alum. D. and S.
Nitrate of Potash. D. and S.
——— Ammonia. D.
——— Barytes. S.
——— Strontian. S.
Muriate of Soda. D. and S.
——— Ammonia. D. and S.
——— Strontian. S.
——— Barytes. S.
——— Lime. D. and S.
——— Alumina. S.
Oxymuriate of Potash. D.
Phosphate of Soda. D. and S.
——— Ammonia. D.
Acetite of Barytes. S.
——— Alumina. S.
Oxalate of Ammonia. S.
Cream of Tartar. D.
Crude Tartar. D.
Tincture of Galls.
Borax. D. and S.
——— vitrified.
Fluate of Ammonia. S.
Succinate of Ammonia. S.
Prussiate of Potash, pure and dry. This should be kept in the dark.
Prussiate of Lime. S.
Plaster of Paris.
White marble.
Bone-ash.
Fluor Spar.
Potash, pure. S.
——— common caustic. S.
Pearl-ash. D. and S.
Salt of Tartar. D. and S.
Super-carbonate of Potash. D.
Carbonate of Soda. D. and S.
——— fully dried.
Ammonia, pure.
Carbonate of Ammonia. D. and S.
Super-carbonate of ditto. D.
Lime.
Lime-water.
Barytic-water.
Strontian-water.
Carbonate of Magnesia.
Hydro-sulphureted water.
Hydro-sulphuret of Soda. S.
——— Ammonia. S.
Sulphuret of Potash. D.
White Arsenic. D. and S.
Manganese, black oxide of.
Mercury.
——— red oxide of.
Nitrate of Mercury. S.
Corrosive muriate of ditto. D. and S.
Zinc, in sticks and granulated.
Tin.
Muriate of Tin.
Lead.
Minium and Litharge.
Nitrate of Lead. S.
Acetite of ditto. S.
Iron, filings, turnings, wire.
Sulphuret of Iron for sulphuretted hydrogen gas.
Sulphate of Iron. D. and S.
——— saturated with nitrous gas.
Muriate of Iron.
Copper, sheet, wire.
Nitrate of Copper. D. and S.
Silver, leaf and wire.
Nitrate of Silver. S.
Sulphate of ditto. S.
Acetite of ditto. S.
Gold-leaf.
Nitro-muriate of Gold.
——— Platina.
Sulphur.
Phosphorus.
Alcohol, concentrated and common.
Sulphuric ether.
Litmus Tincture.
Turmeric.
Brazil wood.
Gall-nut.

Catechu.
Isinglass.
Olive-oil.
Linseed-oil, drying.
Oil of Turpentine.
Black flux.
Distilled water, in great plenty.

The most convenient arrangement for a laboratory where space is not wanted, seems to be that of two rooms, and a shed or apartment which can be thrown open to communicate with the air. The first may contain the books of register, of practical reference, together with the more delicate philosophical and chemical instruments, products, and preparations. The second may be provided with the work-bench, hammers, anvil, vice, and other tools, and the different furnaces; and the shed may be devoted to experiments of danger, such as arise from explosions, noxious vapours, and the breaking of vessels. It will be most convenient that these should be upon the ground floor, to secure the advantage of a ready supply of water or fuel, and other articles of heavy consumption. The first of which articles may be largely wanted, in case of accidental combustion, as well as on common occasions. But it is likewise necessary that the place should be dry, in order that labels may be preserved, and other inconveniences avoided. This is the principal general argument, in favour of a laboratory above the ground floor.

It would carry us too far beyond the limits of our work if we were to give drawings and descriptions of the great variety of vessels, furnaces, and apparatus, which have been contrived for general and particular purposes of chemistry; and many of the culinary and domestic vessels may also be applied in experimental chemistry. We shall therefore confine ourselves to a few of the most simple and useful.

In Plate Laboratory, fig. 1, represents a retort, *a*, and receiver, *b*. These vessels are used for distillation. The subject is put into the belly of the retort, *a*, and exposed to heat, and the volatile products pass over into the receiver, *b*, which may be kept cool by the application of wet cloths, or by immersion in cold water, or otherwise, if needful. The place of junction is secured either by fitting the necks together by grinding, or by means of a lute, which see farther on. At *c*, in the receiver, is a neck closed by a stopper. Receivers or retorts, with this additional neck, are said to be tubulated. Fig. 2, is an alembic, of which *a* is the body, *b* the head, and *c* the neck. Generally speaking, this is not a very useful instrument. In large distillations an alembic or still is used, but the condensation is effected by a spiral pipe, called the worm, which passes through a tub of cold water. In the use of the alembic, fig. 2, the beak is inserted into a receiver. When the volatile product of a body exposed to be dried, or to undergo evaporation by heat, is not required to be preserved, the process is performed in an open vessel.

The application of heat to vessels is made either by naked fire, or by the intervention of some heated substance, which is then called a bath. Chemical baths are made of sand, or of melted lead, or the fusible metal, or of brine, and very frequently of water. The evaporable liquids form a bath which cannot be heated beyond their respective boiling points; and the other baths, the most common of which is that of sand, are chiefly valuable for giving a regular heat without sudden changes.

This last purpose is effected likewise with glass vessels, by coating them with a lute.

A very great number of furnaces have been constructed for chemical and manufacturing purposes, for which we must necessarily refer to the extensive works appropriated to these objects. The operative chemist may have occasion for them of different sizes and figures. A great deal may be done with the common German stove, and with small furnaces made out of black-lead pots. But, in general, the philosophical chemist will be well accommodated with one good furnace, convertible to different uses; and out of many such we select that of Dr. Black, for its simplicity and efficacy, as described in his lectures.

Plate-iron is by far the best material for the outside of an experimental furnace: but, as its metal communicates heat very fast, this must be cut off by a proper lute lining. The Doctor so far succeeded in this respect, that his furnace, though only two inches thick in the middle, will not scorch paper applied to its outside, when it is melting iron within. He adopted the simplest rectilineal shapes, because workmen find great difficulty in executing curved and uncommon forms; and not one of a score of them will do it with accuracy. Indeed, those highly praised forms seemed to him of very little importance in most cases.

The body, or fire-place, is the only part of this furnace that requires description; the ash-pit, with its door and registers and

grate, being constructed as in any other furnace. It will be easily understood by considering the section represented in fig. 3.

The base, represented by the dotted line A B C, and the top, K L M, are oval plates of iron, the longer diameter, A C, being to the shorter as three to two nearly. The base and top are equal, so that the sides, K A, M C, are upright, the whole body forming an oval cylinder. D E F, is half of the hole in the bottom, which is occupied by the grate fixed on the top of the ash-pit. G H I is half of the mouth of the furnace, which receives a still, or a sand-pot, for distillation, with a retort. This is a little nearer to the front, K, of the top, than the grate-hole is to the front, A, of the bottom, so that the luting is thicker below than above. Near the back, M, of the furnace is a smaller hole, P, for the vent. The luting at Q and R is so formed that the cavity of the furnace does not greatly differ from a cylinder, except in so far as the vent, P O, does not communicate with it abruptly, but is gradually curved downwards, as represented in the figure, making the middle of the cavity more roomy backwards, by which means it contains a greater quantity of fuel. S is the section of the luting, which forms a sort of an arch, or bridge, contracting the entry of the vent. An iron pipe is set on at P to increase the draught of the chimney. The fuel is put into the furnace by the aperture P, and the sloping form of the cavity causes it to distribute itself pretty uniformly.

When the furnace is used for smelting, the crucible is set on a pedestal standing on the grate, and the fuel is placed round it with great ease, the mouth of the furnace being open. This is then shut up by a stopper made on purpose, or by a flat fire-tile simply laid on it.

When we would distil with a naked fire, the retort has its bulb resting on a ring which hangs on the mouth of the furnace by three hooks, and the neck of the retort lies over the front of the furnace. The space round the retort, at the mouth of the furnace is closed, as much as is necessary, by two or three pieces of tile, shaped so as nearly to fit the bulb of the retort when they are laid on the mouth of the furnace. A quantity of light ashes are now to be laid on these tiles, and heaped up so as to cover the bulb and part of the neck of the retort. Dr. Black found that this produced a very gradual diminution of the heat, as it recedes from the fuel, and is less liable to crack the retort, by inequality of heat, than any other contrivance. Scarcely any process occurs which this furnace does not answer with great ease.

In using the furnaces most convenient for experimental chemistry, (namely, those made of plate iron) it is necessary that the iron be defended from the heat by lining or lute, as we call it, on the inside; and such lutes are necessary in other occasions in chemistry; as when we have occasion to close the joining of the vessels with one another, or to give a coating to retorts, or even to crucibles, which is sometimes done. The materials employed for these purposes have their general denomination from clay, of which some of the most useful are partly composed, though there are some that do not contain any of it. They may be divided into such as contain animal or vegetable matter, of the glutinous or adhesive kind, and such as are composed only of earthy substances. The first are used for closing the joining of vessels, when the heat we mean to apply is not to be strong, nor the vapours to be produced corrosive. The second serve for the lining of furnaces, or for closing the joinings of vessels, in operations in which the vapours are very corrosive, or in which a strong heat must be employed, which would scorch, or burn and destroy, any animal or vegetable glutinous matter.

The joinings of vessels with one another, which we have the most frequent occasion to close up by means of lutes, are those of retorts with receivers. And we may remark, in the first place, with regard to these, that there are not many operations in which it is necessary to make the joining perfectly close, except when the receiver is provided with an air-pipe. On the contrary, it is dangerous on account of the air which must be allowed to escape in some manner. Therefore we are not anxious to contrive the most close and compact. They are sufficient and better if they be moderately so, and in some cases, when we think the lute too close we even obviate it by a pin-hole. The animal and vegetable lutes, employed in this way, are glue and chalk mixed in thin paste, and spread on slips of paper; or gum arabic and chalk, used in the same manner; or flour and water; or a bladder; or linseed meal; or fat lute. M. Lavoisier recommends, for joinings which we desire to be air-tight, but which are not to be exposed to heat, the following: to sixteen ounces of bees-wax add

one and a half or two of turpentine, and keep it for use. When used, soften and make it tough, by warming and working between the fingers; then put it on the joint in little rolls, and make it close; and, lastly, cover it with slips of wet bladder laced with pack-thread. But, if the joint is liable to be warmed, or heated during the operation, you must take fat lute. This is made of raw pipe-clay and linseed oil, beaten together very hard, to the consistence of a stiff adhesive paste.

Of the second kind of lutes, called the fire-lutes, a great variety have been proposed, and some of them compositions of many ingredients, but none are equal, or superior, to clay and sand; *viz*, sand 3, or 4, or 5, or 6, to clay 1. These are for luting vessels together, and for coatings. But in lining furnaces, Dr. Black used a double lining; first, a charcoal-lute; secondly, a fire-lute.

He found that a layer of powdered charcoal, beaten up, or kneaded, with as little water as will give its particles adhesion enough to attach itself to the metal sides of the furnace, by means of cautious beating, forms a firm stratum, which is the most imperfect conductor of heat of all that he had tried. When this layer of charcoal is defended from the action of the air by a layer of fire-lute, composed of one part of fine clay, and three or four parts of sand, carefully put on, and consolidated by gently beating it from day to day, till it no longer receives an impression from the mallet; it will last as long as any part of the furnace. Its durability will be greatly improved, without much change in its conducting power, by using, instead of pure water, water made muddy by about one-twentieth of pipe-clay. If finely powdered charcoal be kneaded with one-fifth of pipe-clay, it may be kneaded and formed into any shape, and will be so impervious to heat that a bit of it may be held in the fingers within an inch of where it is red hot. Such a composition is, therefore, very proper for the doors of furnaces, and for stopples for such apertures as must be frequently opened and shut.

Fig. 4, represents an Argand's lamp capable of being adjusted at different heights, by a sliding socket, on a stem or rod. Another similar socket is seen above, into which a ring of wire is inserted for supporting the retort, *a*, at any required distance above the flame. A third socket may be added, still higher upon the stem, for supporting another wire, which will afford the means of steadying an alembic, or any other apparatus, by a string or small flexible wire answering the same purpose. This is a very convenient method of disposing vessels for the lamp heat, upon a small or moderate scale, for distillations, sublimation, evaporation, drying, and the like. A small sand-bath may be placed, when needful, in the wire above the flame: *b* is an intermediate condensing vessel, called a quilled receiver, which conveys the condensed product into a bottle, *c*. The rod which supports *b* shows how useful these instruments are in their various applications.

The condensation of vapours after distillation, and the transmission of gases, which may arise along with them to their receptacles, has been very well and scientifically effected by the late Mr. Woulfe, in an apparatus of bottles which is distinguished by his name. The original contrivance will be easily understood by description, and instead of a drawing of that arrangement of vessels, we shall give one of the most simple, safe, and convenient of all the improvements which have since been made in it; namely, that contrived by Dr. Hamilton, and figured at the end of his "Translation of Berthollet on Dying." Suppose the retort and receiver, (fig. 1.) or any other distillatory apparatus, to have a communication from the upper parts of the receiver, *a*, at *c* by a tube leading into a bottle having three necks, and partly filled with water, beneath the surface of which the said tube, after passing this, an air-tight cork was plunged. Another of the necks of the bottle is provided with an upright open tube, also passing a cork and plunged in the water in order that air may enter in case of absorption, or the liquid may rise a little in it, in case of pressure from within. The third neck of the bottle affords a communication by means of a tube with another two necked bottle, fitted up in all respects in the same manner as the bottle communicating with *c*. And in this manner we may conceive a series of three or more bottles, the last of which may communicate with a pneumatic apparatus which is to receive the incondensable gas. This system of bottles and tubes is sometimes fitted together by grinding, and sometimes made secure by lutes; but in most constructions, though the advantages are very considerable, the apparatus is difficult to be put together, and easily deranged or injured.

Fig. 5, represents Dr. Hamilton's appa-

ratus. A is the retort fitted by grinding into a plug or piece, B, represented at *b*, which last is also fitted by grinding into the neck of a globular receiver, C.

The use of the additional piece, *b*, is to afford a due inclination to the retort by an obliquity of its perforation or hole, instead of allowing it to remain horizontal, as it would, if fitted to the hole in C, and also to facilitate the grinding in, of a new retort in the case of breakage. The piece, *b*, has a stopper, *a*, which can be put whenever the retort is taken out, whether for weighing at, or for any other purpose. The first receiver, C, has a smaller neck opposite to B, which is ground into a corresponding neck of D, the second receiver, which last is tubulated, and has a tube, H, open at both ends, ground into its vertical neck for the purpose of permitting absorption and re-acting, by its contents, against the force required to protrude any gas through the bended tube, I K L. Every one of the range of the receiver, E F G, has also two necks, by which they are successively fitted to each other, and each interior neck has a tube of about a quarter of an inch fitted into it, which, by its curvate, reaches nearly to the bottom of the liquid (usually water) placed in each. By this disposition the usual first product of condensation is received in C, and the purer vapours proceeding to D, are in part condensed by the water placed therein, and are partly urged through the tube, I, into contact with the water in E: and whatever may escape condensation in E, will be urged through the tube, K, into the liquid in F; and in this manner the operation may proceed through the whole set of vessels, till the gasiform remaining product, if any, shall pass out then beneath the mouth of one or the other of the three inverted bottles, at P, which are filled with water, and have their mouths immersed below the surface of the water, in a dish at the end of the series. S and *s* are a pair of pieces of wood which serve to support one of the globes, and very conveniently afford an adjustment, by pressing them more or less near together. This apparatus is drawn upon a scale of about half an inch to a foot, which is a proper size to be worked by an Argand's lamp; if it were made larger, the retort would of course require to be supported as usual, by the parts of the furnace, or otherwise.

The dish and bottles at the extremity of this apparatus show how the gases or permanently elastic fluids are received and managed. For such gases as are not absorbed by water, a wooden tub may be used, having a shelf therein, at such a depth as to stand a little below the intended surface of the water; or, instead of a shelf, a short-legged stool, loaded with lead, may be used, and in that case any tub or vessel may be used. Jars, or vessels of any convenient figure, being filled with water by immersion, and turning them bottom upwards, may be placed on the shelf, which should have holes in it for the convenience of pouring up any gas, whether from another jar, bottle, or vessel, or from the neck or tube of a retort, or other apparatus. Jars, &c. thus filled may be conveyed away, either by corking the bottle, or by putting a saucer, or other shallow vessel, beneath the mouth of the jar, and taking both out together, with water in the saucer.

Gases which are absorbed by water are usually received over mercury, in which case, on account of the weight, as well as the expence of the fluid, the vessels are made smaller, and the trough has a deep cavity sufficient for immersion, but no larger, and a broad shallow part of the trough supplies the place of a shelf for the jars to stand upon; and there is an actual shelf at one part only over the end of the deep cavity. Fig. 6, represents a trough for mercury, which may be made of wood or of stone. The space, V, admits the jar, A, to be immersed, and when full it is raised and placed bottom downwards upon the shallow bottom. G is a retort, containing some materials from which gas, being extricated, rises beneath A, and displaces the mercury. X and Y are grooves, into which one or more wooden shelves may be slided, as occasion may require, in which application they are first introduced at the wider part, T, in the plan, fig. 7.

An apparatus, almost indispensable in experiments on the gases, is a gazometer, which enables the operator to receive and preserve large quantities of gas with the aid of only a few pounds of water. These vessels are made of various forms, but one of the most simple is shown in fig. 8. It consists of an outer fixed vessel, *d*, and an inner moveable one, *c*, both of japanned iron. The latter slides easily up and down within the other, and is suspended by cords passing pullies, to which are attached the counterpoises, &c. To avoid the incumbrance of a great weight of water, the outer vessel, *d*, is made double, or is composed of two

and it is now become usual for chemists, among their other experiments on minerals, to mention their habitudes with the blow-pipe.

The fluxes which have obtained the general sanction of chemists, on account of the extensive use they have been applied to by Bergman, are phosphoric acid in the dry or glassy state, soda, and borax or the native borate of soda.

LABOUR, in general, denotes a close application to work or business. Among seamen a ship is said to be in labour when she rolls and tumbles very much, either a hull under sail, or at anchor. It is also spoke of a woman in travail, or child-birth. See MIDWIFERY.

LABRADOR *stone*, in mineralogy, is of a grey colour, passing into a dark ash. It exhibits, however, under certain circumstances, a great variety of colours, as blue, green, yellow, red, and brown, in their different shades. It shows, likewise, spotted and striped delineations. Sometimes the same spot if held in different directions changes its colour from blue to green, &c. The beautiful colours seldom extend over a whole piece; in general, they show themselves only in large and smaller spots and patches. Different colours are presented according as the piece is held between the light and the eye, or the eye and the light. It occurs massive, in blunt edged and rolled pieces. Its principal fracture is shining, passing into splendent. Specific gravity is about 2.7. It runs into a white enamel, with addition before the blow-pipe. The constitutent parts are

Silica	69.5
Alumina	13.6
Sulphate of lime	12.0
Oxide of copper	0.7
Oxide of iron	0.3
	96.1

It makes a part of certain kinds of green stone, and is accompanied with mica and shorl, though seldom with iron pyrites. It was originally discovered by the Moravians, in the island of St. Paul, on the coast of Labrador, where it is still to be met with in plenty, also in some parts of Denmark and Norway, and near the romantic Lake of Baikel in Siberia. It is used for many ornamental purposes.

LABRUS, in natural history, a genus of fishes of the order Thoracici. Generic character: teeth strong and sharp; the grinders sometimes convex and crowded; lips thick and doubled; rays of the dorsal fin in several species prolonged into soft processes; gill-covers unarmed and scaly. There are ninety-eight species enumerated by Shaw, of which we shall notice merely the following: L. scarus, is about the length of twelve inches, and is found in the Mediterranean in immense shoals. It was well known to the ancients, and highly admired by them, being considered as one of the most luxurious dainties. For a representation of the blue-finned Labrus, see Plate V. fig. 2.

LABYRINTH, in anatomy, the internal cavity of the ear, so called from sinuosities and windings. See EAR.

LABYRINTH, in gardening, a winding mazy walk between hedges, through a wood or wilderness. The chief aim is to make the walks so perplexed and intricate that a person may lose himself in them, and meet with as great a number of disappointments as possible. They are rarely to be met with except in great and noble gardens, as Versailles, Hampton court, &c. There are two ways of making them; the first is with single hedges: this method has been practised in England: and these may, indeed, be best, where there is but a small spot of ground allowed for making them; but where there is ground enough the double is most eligible. Those made with double hedges, with a considerable thickness of wood between them, are approved as much better than single ones: this is the manner of making them in France and other places; of all which that of Versailles is allowed to be the noblest of its kind in the world. It is an error to make them too narrow; for that makes it necessary to keep the hedges close clipped: but if, according to the foreign practice, they are made wide, they will not stand in need of it. The walks are made with gravel usually set with horn-beam: the pallisades ought to be ten, twelve, or fourteen feet high: the horn-beam should be kept cut, and the walks rolled.

LAC, *gum*, in chemistry, is a very singular compound, prepared by the female of a very minute insect, the coccus lacca, found on some trees in the East Indies, particularly the banyan fig. The insect is nourished by the tree, fixing itself upon the twigs and extremities of the succulent branches, where it deposits its eggs, which it glues to the branch by a red liquid, the outside of which hardens by the air, and serves as a cell for the parent insect. This increases in size,

and the young insects at first feed upon the enclosed liquid, and after this is expended they eat through the coat, leaving a hollow red resinous bag which is "stick-lac." The best lac is procured from the province of Acham, but it is obtained in great plenty on the uncultivated mountains on each side of the Ganges. There are four kinds of lac, viz. "stick-lac," which is lac in its natural state, without any preparation; "seed-lac," which is stick-lac broken into small lumps, and granulated; "lump-lac," which is seed-lac liquified by fire; "shell-lac," which is a preparation of the stick-lac. By a number of very accurate experiments made by Mr. Hatchett, it is found that lac consists of a colouring extract, of resin, gluten, and wax; all of them in intimate combinations: the proportions of the stick-lac are as follow:

Resin	68.0
Wax	6.0
Gluten	6.5
Colouring extract	10.0
Extraneous substances	6.5
	96.0

Lac is employed for a variety of purposes in the arts: the finer specimens are cut into beads for necklaces. It enters largely into the composition of sealing-wax, and hard japans or varnishes: and it is much used in dying.

Lac *sulphuris*, in medicine, a sulphur separated by acid from its alkaline solution. In this state it is thought to be milder and a more efficacious medicine than in its crude state, and is certainly less nauseous to the taste. See Sulphur.

LACCIC *acid*, in chemistry, a white or yellowish production of insects, called white-lac. Some of this substance, brought from Madras, was analyzed by Dr. Pearson, who found that it bore a considerable analogy to bees-wax. A full account of Dr. Pearson's experiments may be seen in the eighty-fourth volume of Philos. Trans. The component parts of this acid are supposed to be carbon, hydrogen, and oxygen.

LACE, in commerce, a work composed of many threads of gold, silver, or silk, interwoven the one with the other, and worked upon a pillow with spindles, according to the pattern designed. The open-work being formed with pins, which are placed and displaced as the spindles are moved.

Lace, *bone*, a lace made of fine linen, thread, or silk, much in the same manner as that of gold and silver. The pattern of the lace is fixed upon a large round pillow, and pins being stuck into the holes or openings in the pattern, the threads are interwoven by means of a number of bobbins made of bone or ivory, each of which contains a small quantity of fine thread, in such a manner as to make the lace exactly resemble the pattern. There are several towns in England, and particularly in Buckinghamshire, that carry on this manufacture; but vast quantities of the finest laces have been imported from Flanders.

LACERTA, the *lizard*, in natural history, a genus of Amphibia, of the order Reptiles. Generic character: body four-footed, tailed, naked and long, having no secondary integument; legs equal. There are, according to Gmelin, eighty-one species, of which the following are principally deserving of attention. L. crocodilus or the crocodile, is a native both of Africa and Asia, but is most frequently found in the former, inhabiting its vast rivers, and particularly the Niger and the Nile. It has occasionally been seen of the length of even thirty feet, and instances of its attaining that of twenty are by no means uncommon. It principally subsists on fish, but such is its voracity, that it seizes almost every thing within its reach. The upper part of its body is covered with a species of armour, so thick and firm, as to be scarcely penetrable by a musket ball, and the whole body exhibits the appearance of an elaborate covering of carved work. It is an oviparous animal, and its eggs scarcely exceed in size those of a goose. These eggs are regarded as luxuries by the natives of some countries of Africa, who will also with great relish partake of the flesh of the crocodile itself. When young, the small size and weak state of the crocodile prevent its being injurious to any animal of considerable bulk or strength, as those which have been brought living to England have by no means indicated that ferocious and devouring character which they have been generally described to possess, a circumstance, probably, owing to the change of climate, and the reducing effect of confinement. In its native climate its power and propensity for destruction are unquestionably great, and excites in the inhabitants of the territories near its haunts a high degree of terror. It lies in wait near the banks of rivers, and with a sudden spring, seizes any animal that approaches within its reach, swallowing it by an instantaneous effort, and then rushing

back into its watery recesses, till renewed appetite stimulates the renewal of its insidious exertions. These animals were occasionally exhibited by the Romans among their collections of the natural wonders of the provinces, and Scaurus and Augustus are both recorded to have entertained the people with the sight of these new and formidable objects. It is reported by some travellers, that crocodiles are capable of being tamed, and are actually kept in a condition of harmless domestication at the grounds and artificial lakes of some African princes, chiefly as appendages of royal splendour and magnificence. A single negro will often attack a crocodile, and by spearing it between the scales of the belly, where it is easily penetrable, secure its destruction. In some regions these animals are hunted by dogs, which, however, are carefully disciplined to the exercise, and are armed with collars of iron spikes. Aristotle appears to have been the first who asserted that the under jaw of the crocodile was immovable, and from him the idea was transmitted and believed for a long succession of ages. But the motion of the jaw in this animal is similar to that of all other quadrupeds. The ancients also thought it destitute of a tongue, an idea equally false. The tongue, however, is more fixed in this than in most animals to the sides of the mouth, and less capable therefore of being protruded. The eggs of the crocodile are deposited on the mud or sand of the banks of rivers, and, immediately on being hatched, the young move towards the water, in their passage to which, however, vast numbers are intercepted by ichneumons and birds, which watch their progress. See Amphibia, Plate I. fig. 4.

L. alligator, the alligator, differs from the former species principally in being more smooth on the upper part of the head, and on the snout being much wider and flatter, and rounder at the end. It grows to the length of eighteen feet, and abounds particularly in the torrid zone, but it is found so far north as the river Neus in North Carolina. It is met with both in the fresh and salt parts of rivers, and amidst the reeds along the banks, lurks in ambush for its prey, seizing upon dogs and cattle which approach within the reach of its fatal bound. Alligators are equally formidable in their appearance, and ferocious in their dispositions, seizing both man and beast with almost indiscriminating voracity, and pulling them to the bottom to lessen their means of resistance, and devour them with less interruption. By the close union of the vertebræ, this animal can proceed with celerity only in a straight forward direction, so that the intended victims pursued by them, are enabled to elude this destination by lateral and cross movements. But though the alligator is deficient in flexibility, it supplies this defect in a great degree by sagacity or cunning, and appearing on the surface of the water like the stock of a tree, he thus attracts various animals within its grasp. Fowls, fishes, and turtle, all are drawn, whether by curiosity or for convenience, towards this object, supposed completely harmless, but from which the jaws of destruction are instantly opened to devour them. Alligators are said to swallow stones and various other substances incapable of affording nourishment, merely to prevent the contraction of their intestines, and thus allay their hunger; and Catesby observes, that on opening a great number, he has seen nothing but clumps of light wood and pieces of pine tree coal (in one instance a piece of the weight of eight pounds) worn by attrition to a surface perfectly smooth, implying that they had long remained in their bodies. Their eggs are deposited on the banks of rivers, and sometimes in a nest composed of vegetables with considerable care, and are hatched by the sun, and the young ones are not only devoured by fishes and birds, but become the victims often of their own voracious species. In Carolina they seldom attack men or large cattle, but are formidable enemies to hogs. From October to March they continue in the sequestered caverns of the river banks in a state of torpor, re-appearing in the spring with the most violent and terrific noises. Some parts of them are used by the Indians for food, and the flesh is of an attractive whiteness, but has a very strong flavour of musk. The growth of this animal, and of the crocodile, is extremely slow, and both are imagined to be long lived. See Amphibia, Plate I. fig. 2.

L. iguana, or the great American guana, is found in various parts of America and the West Indies. Its colour is generally green. Its back exhibits the appearance of a saw, and it is distinguished by a pouch under the throat, which it is able to extend or contract at pleasure, and which gives it occasionally an appearance truly formidable. It is formidable, however, only in appearance, being in fact perfectly inoffensive. Its general length is from three to five feet; it inhabits rocks and woods, and subsists on ve-

getable food and certain species of insects. The guanas deposit their eggs (which have no testaceous covering, and are much valued for food) in the earth where they may be warmed by the beams of the sun, and leave them to be matured solely by its influence. The natives of the Bahamas train dogs to the pursuit of these animals, and a well disciplined dog will take them alive, in which case they are carried for sale to the markets of Carolina in the holds of vessels; those which are destroyed or lacerated by the dogs, are salted and barrelled, and kept for the home consumption. Their flesh is reported to be easily digestible, delicate, and well flavoured. They will keep under water for nearly an hour; when they swim, their feet are kept close to their bodies, and they appear to produce and regulate their motions merely by their tails. Whatever they eat they swallow whole. They have been kept without food a very considerable time. Their colour is much affected by the state of the weather, or the dampness or dryness of their habitation. They may be easily tamed if taken young.

L. basiliscus, or the basilisk, is particularly distinguished by a broad wing-like process, elevated along the whole length of its back, somewhat similar to the fins of fishes, and which is capable, at the pleasure of the animal, of being extended or contracted. It lives almost solely in trees, feeding upon insects, and though somewhat terrific in appearance, is as harmless as any of the lizard tribe. It is found most frequently in South America, generally about a foot and a half long, swims with great ease, and moving among the branches of the trees with extreme agility, sometimes apparently with a short flight, which is aided by the remarkable process above mentioned, on its back. The basilisk of antiquity, whose bite was supposed to be more speedily mortal than that of any other creature, and whose look even carried destruction with it, is to be ranked with the fabulous monsters, which in the prevailing ignorance of nature that attended those times, were amply supplied by a poetic imagination. See Amphibia, Plate I. fig. 3.

L. monitor, or the black lizard, measures frequently four and sometimes five feet, being one of the largest as well as the most elegant of the tribe. It is found principally in woody and moist situations in South America, and is reported to give indications of attachment and gratitude to those by whom it has been fed, and familiarised to be as mild in its manners and temper as it is elegant in its form.

L. agilis, or the green lizard, is abundant in all the warmer latitudes of Europe, sometimes attaining the length of more than two feet, but in general not exceeding one. Its colouring is more beautiful than that of any of its tribe in this quarter of the world. About the southern walls of gardens, it is particularly seen pursuing insects with great alertness and dexterity, and both in attack and escape its agility is truly admirable. It may to a certain degree be tamed and familiarised, and in this state is by many considered not only as a perfectly harmless, but as a favourite animal.

L. chamæleon, the chameleon, is generally of the length of ten inches without the tail, which is equally long. Its food consists of insects, which it procures by protruding the tip of its tubular and lengthened tongue with inconceivable celerity, and never failing to retract with it the prey at which it was darted. In India and Africa, and various other parts of the world, these animals are found in great abundance. They are perfectly inoffensive, and can endure a long abstinence, from which latter circumstance the idea of their living upon air alone, may not unnaturally have been derived. They occasionally retain the air in their lungs for a very considerable time, and thus assume an appearance of fullness and fleshiness which is in perfect contrast to that which they will suddenly exhibit, in consequence of the total expulsion of the air from the lungs, during which they are collapsed and seemingly emaciated. A change of colour is sometimes observed in many of the lizard tribe, but particularly so in the chameleon; but the long prevailing idea of the adaptation of its colour to that of any substance with which it is surrounded is totally groundless. Its varieties in this respect appears to extend (in consequence principally, of varied health or temperature) from its natural green-grey into very pale yellow, with irregular patches of red. When exposed to the sun, considerable changes in the shading and patching of its colours are observable; and when, after being wrapped in white linen by some members of the French Academy it reappeared within two or three minutes, it partook somewhat, but very far from completely of the colour of it. On being folded up in substances of various other different colours, it borrowed neither of them, and exhibited no interesting change. The

movements of the chameleon are extremely slow, and in passing from branch to branch its tail is coiled for security round one till its feet have been extended to the other.

L. salamandra, or the salamander, is of a deep brilliant black colour, varied with irregular patches of bright yellow. It is found in various parts of France, Germany, and Italy, abounding particularly in moist and woody situations, and making its appearance chiefly during rain. In winter it secludes itself in clefts, or hollow trees. It is about seven inches long, lives principally upon insects and snails, can subsist by water as well as land, is slow in its movements, and lethargic in its habits. The idea of its being capable of enduring fire without injury, can be accounted for, merely from its possessing a power of exuding in any state of irritation a white and glutinous substance, which must of course tend to render the application of fire less immediately destructive to it than to some other animals, and considering what trifling causes have led, in innumerable cases to important inferences, this fact may probably have given rise to the notion of the salamander being insusceptible of destruction, and even of injury in the midst of flames. The idea of its poisoning any large animal by its bite is equally exploded. The common lizard, however, is stated to have been poisoned in consequence of the bite of the salamander, from some particular fluid contained in the skin of the latter. The salamander produces its young living, hatched from internal eggs, and frequently upwards of thirty in number.

L. aquatica, or the common water newt, is generally about three inches and a half in length, and is found in this country in almost all its stagnant waters. Newts frequently cast their skins with the most complete wholeness, even to the exquisitely delicate and filmy coverings of the eye. In the power of reproduction they resemble the cancer genus. The loss of a leg is reported by Dr. Blumenbach to be easily repaired by renovation, and it is added that the same circumstance occurs with respect to the eyes. The tenaciousness of life exhibited by these animals is remarkable. They have often been found inclosed in large masses of ice, in which they must have been confined for days, weeks, or, even in some instances, for months; and, on being freed from their prison, have soon displayed all the alertness and vigour of perfect health.

LACHENALIA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Coronariæ. Asphodeli, Jussieu. Essential character: corolla six-parted; the three outer petals difform; capsule three-winged; cells many-seeded; seeds globular, affixed to the receptacle. There are twelve species, all bulbous rooted plants, and natives of the Cape of Good Hope.

LACHES, in law, signifies slackness or negligence; as when we say, "there is a laches of entry," it means the same as to say, there is lack or neglect of entry.

LACHNÆA, in botany, a genus of the Octandria Monogynia class and order. Natural order of Veprecula. Thymelææ, Jussieu. Essential character: calyx none; corolla four-cleft, with an unequal border; seed one, like a berry. There are two species, viz. L. eriocephala, woolly-headed lachnæa; and L. conglomerata, cluster-headed lachnæa; these are both shrubs, and natives of the Cape of Good Hope.

LACHRYMAL, in anatomy, an appellation given to several parts of the eye, from their serving to secrete the tears. The lachrymal gland is situated in the orbit above the smaller angle, and its excretory ducts under the upper eye-lid: these are much more easily demonstrated in the eye of an ox than in a human one.

LACIS, in botany, a genus of the Polyandria Digynia class and order. Essential character: calyx none; corolla none; filaments winged on both sides below; receptacle girt, with twelve spines; capsule ovate, eight-streaked, one-celled, two-valved, many-seeded. There is but one species, viz. L. fluviatilis; this plant is called by the natives moureron; it is a native of Guiana, and has been found only on the rocks of the great cascade of the river Sinemari; it is always under water, except the flowering branches; it is attached to the rocks by packets of small fibres.

LACISTEMA, in botany, a genus of the Monandria Digynia class and order. Essential character: calyx scale of the ament; corolla four-parted; filaments bifid; berry pedicelled, one-seeded. There is but one species, viz. L. myricoides, found in Surinam and Jamaica.

LACTATES, combinations of earths and alkalies, &c. with the LACTIC *acid*, which see.

LACTEAL *vessels*, in anatomy, fine subtle canals situated in the intestines and me-

sentry, and serving to convey the chyle to its destined place. See CHYLE.

LACTESCENT, in botany, a term applied to the juices of plants, of whatever colour, which flow out of plants when any injury is done them. The colour is either white, as in the campanula, maple, dandelion, &c.; or yellow, as in the celandine, &c.; or red, as in the bloody dock. Most lactescent plants are poisonous, excepting those with compound flowers, which are generally of an innocent quality.

LACTIC *acid*, in chemistry, is contained in milk, and was discovered by Scheele, to whom modern chemistry is indebted for much important knowledge. The formation of this acid depends on the change of the saccharine mucous matter; for after the acid is once well formed, when the serous part of the milk reddens vegetable blues, no more is obtained by evaporation and crystallization. Scheele obtained this acid by the following process: he evaporated sour whey to one-eighth of its bulk, and then filtered it to separate the coagulated cheesy matter. He then added lime water to precipitate the phosphate of lime, and diluted the liquid with pure water. He next precipitated the excess of lime by means of the oxalic acid, and then evaporated the solution to the consistence of honey, poured on a quantity of alcohol which separates the portion of sugar, of milk, and other extraneous matter, and dissolves the lactic acid, and distilled the clear filtered liquor till the whole of the alcohol employed be driven off: what remains is the lactic acid. This acid is never crystallised, but always appears in the form of a viscid mucilaginous substance; it has a sharp taste; it reddens tincture of turnsole; and gives a reddish shade to the syrup of violets. It combines with alkalies, earths, and metallic oxides; and forms with them lactates.

LACTUCA, in botany, *lettuce*, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ Semiflosculosæ. Cichoraceæ, Jussieu. Essential character: calyx imbricate, cylindrical, with a membranaceous margin; receptacle naked; seeds even, with a simple stipitate down. There are eleven species, of which L. sativa, the common garden lettuce, with its several varieties are too well known to need a particular description.

LACUNAR, in architecture, an arched roof or ceiling, more especially the planking or flooring above porticos and piazzas.

LADDERS, *scaling*, in the military art, are used in scaling when a place is to be taken by surprise. They are made several ways; sometimes of flat staves, so as to move about their pins and shut like a parallel ruler, for conveniently carrying them: the French make them of several pieces so as to be joined together, and to be capable of any necessary length: sometimes they are made of single ropes knotted at proper distances, with iron hooks at each end, one to fasten them upon the wall above, and the other in the ground; and sometimes they are made with two ropes, and staves between them to keep the ropes at a proper distance, and to tread upon. When they are used in the action of scaling walls they ought to be rather too long than too short, and to be given in charge only to the stoutest of the detachment.

The soldiers should carry these ladders with the left arm passed through the second step, taking care to hold them upright close to their sides, and very short below, to prevent any accident in leaping into the ditch. The first rank of each division, provided with ladders, should set out with the rest at the signal, marching resolutely with their firelocks slung, to jump into the ditch; when they are arrived they should apply their ladders against the parapet, observing to place them towards the salient angle rather than the middle of the curtain, because the enemy has less force there. Care must be taken to place the ladders within a foot of each other, and not to give them too much nor too little slope, so that they may not be over-turned, or broken with the weight of the soldiers mounting upon them. The ladders being applied, they who have carried them, and they who come after should mount up and rush upon the enemy sword in hand; if he who goes first happens to be overturned, the next should take care not to be thrown down by his comrade; but on the contrary, immediately mount himself so as not to give the enemy time to load his piece. The success of an attack by scaling is infallible, if they mount the four sides at once, and take care to shower a number of grenades among the enemy, especially when supported by some grenadiers and piquets, who divide the attention and share the fire of the enemy.

LADEN; the state of a ship when she is charged with a weight or quantity of materials equal to her tonnage or burthen. If the goods with which she is laden be extremely heavy, her burthen is determined by the weight thereof; but if light, she

carries as much as she can stow for the purposes of navigation. As a ton in measure is generally estimated at 2000 pounds in weight, a vessel of 200 tons ought accordingly to carry a weight equal to 400,000 pounds; therefore, when the matter of which the cargo is composed is specifically heavier than the water in which she floats; or, in other words, when the cargo is so heavy that she cannot float high enough with so great a quantity of it as her hold will contain, a diminution thereof becomes absolutely necessary.

LAETIA, in botany, so named from John de Laet of Antwerp; a genus of the Polyandria Monogynia class and order. Natural order of Tiliaceæ, Jussieu. Essential character: calyx five-leaved; corolla five-petalled, or none; fruit one-celled, three-cornered; seeds with a pulpy aril. There are four species, of which L. guidonia is a tree which grows to a considerable size in Jamaica, and is esteemed highly for its fine timber, which is much used in all sorts of building; in the fruit of this tree, the lines between the valves are of a beautiful red colour, as well as the placentæ; the filaments of the flower are very numerous.

LAGERSTROEMIA, in botany, so named from Magnus Lagerstroem, of Gottenburgh; a genus of the Icosandria Monogynia class and order. Natural order of Salicariæ, Jussieu. Essential character: calyx six-cleft, bell-shaped; petals six, curled; stamina very many, the six outer thicker than the rest, and longer than the petals. There are four species, of which L. indica, according to Linnæus, is a tree the size of a pomegranate, with opposite leaves, sub-sessile, oblong, quite entire, smooth; the floral leaves roundish; flowers flesh-coloured, in a loose terminating thyrse, on trifid or three-flowered pedicels; the petals, on long claws, six in number, curled and waved. Native of the East Indies, China, Cochin China, and Japan.

LAGOECIA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Umbellatæ, or Umbelliferæ. Essential character: involucre universal, and partial: petals bifid; seeds solitary, inferior. There is but one species, *viz.* L. cuminoides, wild or bastard cumin: this is an annual plant, about a foot high; the leaves resemble those of honeywort: the flowers are collected into spherical heads, at the extremity of the stalks, and are of a greenish yellow colour. Native of the Levant.

LAGUNŒA, in botany, so called from Andreas Laguna, a Spanish physician and botanist; a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx simple, five-cusped; style simple; stigma peltated; capsule five-celled, five-valved. There are three species, of which L. aculeata, prickly lagunœa, has a round tomentose stem, armed with small upright prickles, a little branched, and is about a foot and a half in height; leaves alternate, shorter than the petioles, deeply divided into three serrate-toothed segments, the middle one longer than the others; flowers on short peduncles; calyx tomentose, terminating in five short awl-shaped points, bursting on one side to the middle, when the corolla expands, which is yellow, and twice as long as the calyx; filaments short, scattered over the whole surface of the tube; stigma red, peltate, scarcely standing out; capsule oblong, acuminate, five-cornered, tomentose; seeds kidney-form, black. It is a native of Coromandel, near Pondicherry, where it is call-by the inhabitants, Cattacacheree.

LAGURUS, in botany, a genus of the Triandria Digynia class and order. Natural order of Gramina, Gramineæ, or Grasses. Essential character: calyx two-valved, with a villose awn; corolla having, on the outer petal, two terminating awns, and a third dorsal one, twisted back. There is but one species, *viz.* L. ovatus, an annual grass, eighteen inches or more in height; very soft and hoary, as are also the leaves and spikes. Native of the South of Europe.

LAKE, in the arts, is a combination of colouring extract, with an earth, or metallic oxide, formed by precipitation from the solution of the colouring matter. If a solution of alum is added to an infusion of madder, a mutual decomposition takes place, and part of the alumine falls united with the colouring matter of the madder. Precipitates, of different shades of colour, are obtained with alum, nitre, chalk, acetate of lead, and muriate of tin. The lakes form some of the beautiful pigments, and are highly esteemed in water-colour painting, and other purposes: and they are almost invariably composed, either of alum, or sometimes the solutions of tin, and some other watery solution of a colouring matter. See Colour.

LAMA, the sovereign pontiff, or rather god of the Asiatic Tartars, inhabiting the country of Barantola. The Lama is not only adored by the inhabitants of the coun-

try, but also by the kings of Tartary, who send him rich presents, and go in pilgrimage to pay him adoration, calling him *Lama congiu*, i. e. god, the everlasting father of heaven. He is never to be seen but in a secret place of his palace, amidst a great number of lamps, sitting cross-legged upon a cushion, and adorned all over with gold and precious stones; where, at a distance, they prostrate themselves before him, it not being lawful for any to kiss even his feet. He is called the Great Lama, or Lama of Lamas, that is, priest of priests: and, to persuade the people that he is immortal, the inferior priests, when he dies, substitute another in his stead, and so continue the cheat from generation to generation. These priests persuade the people, that the Lama was raised from death many hundred years ago, that he has lived ever since, and will continue to live for ever.

LAMB. See Ovis.

LAMINÆ, the thin plates of which any thing consists: hence the epithet laminated, which is applied to those bodies whose texture discovers such a disposition as that of plates lying over one another.

LAMIUM, in botany, *archangel*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: corolla upper lip entire, vaulted; lower, two-lobed; throat with a reflex toothlet on each side. There are thirteen species, several of which are considered as weeds, rather than garden plants. The L. album, white archangel, or dead nettle, is common in hedges, on banks, and by road-sides; flowering in April and May, when it is much resorted to by bees, for the honey secreted in the bottom of the tube, by the gland that surrounds the base of the germ. This plant has a disagreeable smell when bruised. Phalæna Chrysitis, or burnished-brass moth feeds on it: Linnæus says, the leaves are eaten in Sweden as a pot-herb, in the spring; no cattle, however, seem to touch it; and, having a strong, creeping, perennial root, it should be extirpated, which is not difficult.

LAMP, *Argand's*. This is a very ingenious contrivance, and the greatest improvement in lamps that has yet been made. It is the invention of a citizen of Geneva; and the principle on which the superiority of the lamp depends is the admission of a larger quantity of air to the flame than can be done in the common way. This is accomplished by making the wick of a circular form, by which means a current of air rushes through the cylinder on which it is placed with great force; and, along with that which has access to the outside, excites the flame to such a degree, that the smoke is entirely consumed. Thus both the light and heat are prodigiously increased, at the same time that there is very considerable saving in the expense of oil, the combustion being exceedingly augmented by the quantity of air admitted to the flame; and that what in common lamps is dissipated in smoke is here converted into a brilliant flame. This lamp is now very much in use; and is applied not only to the ordinary purposes of illumination, but also to that of a lamp furnace for chemical operations, in which it is found to exceed every other contrivance yet invented. It consists of two parts; *viz.* a reservoir for the oil, and the lamp itself. The reservoir is usually in the form of a vase, and has the lamp proceeding from its side. The latter consists of an upright metallic tube, about one inch and six-tenths in diameter, three inches in length, and open at both ends. Within this is another tube, about an inch in diameter, and nearly of an equal length; the space betwixt the two being left clear for the passage of the air. The internal tube is closed at the bottom, and contains another similar tube, about half an inch in diameter, which is soldered to the bottom of the second. It is perforated throughout, so as to admit a current of air to pass through it; and the oil is contained in the space betwixt the tube and that which surrounds it. A particular kind of cotton cloth is used for the wick, the longitudinal threads of which are much thicker than the others, and which nearly fills the space into which the oil flows; and the mechanism of the lamp is such, that the wick may be raised or depressed at pleasure. When the lamp is lighted, the flame is in the form of a hollow cylinder; and by reason of the strong influx of air through the heated metallic tube becomes extremely bright, the smoke being entirely consumed for the reasons already mentioned. The heat and light are still farther increased, by putting over the whole a glass cylinder, nearly of the size of the exterior tube. By diminishing the central aperture the heat and light are proportionably diminished, and the lamp begins to smoke. The access of air both to the external and internal surfaces of the flame is indeed so very necessary, that a sensible difference is perceived when the hand is

held even at the distance of an inch below the lower aperture of the cylinder; and there is also a certain length of wick at which the effect of the lamp is strongest. If the wick be very short, the flame, though white and brilliant, emits a disagreeable and pale kind of light; and if very long, the upper part becomes brown, and smoke is emitted. The saving of expense in the use of this instrument for common purposes is very considerable. By some experiments it appears, that the lamp will continue to burn three hours for the value of one penny; and the following was the result of the comparison between the light emitted by it and that of a candle. The latter having been suffered to burn so long without snuffing, that large lumps of coaly matter were formed upon the wick, gave a light at 24 inches distance equal to the lamp at 129 inches: whence it appeared, that the light of the lamp was equal to 28 candles in this state. On snuffing the candle, however, its light was so much augmented, that it became necessary to remove it to the distance of 67 inches, before its light became equal to that of the lamp at 129 inches: whence it was concluded, that the light of the lamp was somewhat less than that of four candles fresh snuffed. At another trial, in which the lamp was placed at the distance of 131½ inches, and a candle at the distance of 55 inches, the lights were equal. In these experiments the candles made use of were 10¼ inches long, and $2\frac{1}{10}$ inches in diameter. When the candle was newly snuffed it appeared to have the advantage; but the lamp soon got the superiority; and on the whole it was concluded, that the lamp is at least equivalent to half a dozen of tallow candles, of six in the pound; the expense of the one being only 2¼*d.* and the other 8*d.* in seven hours.

We shall now give a more particular description of Argand's lamp, with reference to figures. Fig. 1, Plate Argand's Lamp, is an upright elevation: fig. 2, a section; and figs. 3, 4, and 5, parts of this useful instrument. A A (fig. 1 and 2) is a reservoir containing oil, whose shape is immaterial; in the present instance it is that of an urn: B is a tube to convey the oil to the lamp, where it is consumed. The lamp is composed of several tubes, one within the other: the external, *a a*, is only a case to defend the others within it, having a small cup, *b b*, screwed to it at bottom, to receive the dropping of oil: at *d* the tube is enlarged by a projection soldered to it, and into which the tube B delivers the oil it brings from the urn A A: *e e* (fig. 2) is the second tube, supported concentrical with the other by the enlargement *d*, which it is open to all down one side; the oil, therefore, has free passage into this tube; but as it is closed at bottom, and the cavity, *d*, tight, it cannot get in the external tube, *a a*: *f f* is the internal tube, supported by being soldered to the bottom of the second, *e e*: another moveable tube is placed between the tube *e e* and *f f*, as seen in the section (fig. 2), but better explained in a separate figure (fig. 4), where *g h* is the tube; it is divided by a slit from top to bottom on the side *g*; on each side of this slit a small piece of brass plate, *i*, is soldered to support a frame, *k*, in which a small pinion works (as shewn in fig. 2); this pinion gives motion to a rack, *l*, (fig. 5) bent at right angles at the lower end, and holding a short tube, or rather ring, *m*, on which the wick, *n*, is held; this ring and the wick slides within the tubes *g h*, and outside of the internal tube, *f f*, its arm connecting it with the rack, *l*, goes first through the slit down the side, *g*, of the tube (fig. 4), and next through the opening in the side of the tube, *e e*, where it communicates with the cavity *d*. At the top of the lamp a glass chimney, *o o*, is fixed, (as shewn in fig. 3), where *o o* is the glass tube, with a small enlargement or ring at the bottom: *p p* is a brass ring going over the glass, and catching the rim at the bottom; it is cut into a female screw withinside, and screwed upon another ring, *r*; this presses against the bottom edge of the glass tube, and thus holds it fast between them: the ring *r* fits tight by friction upon the top of the tube *a a*; but so as to be easily removed when the glass is to be cleaned or taken away. The great advantage of this lamp is, that the wick is hollow, and the air brought to it, both on the inside by the tubes *f f*, and outside between the tubes *e e* and *a a*, and by the rarefaction of the air in the glass chimney, a considerable draught is created, and the air forming, which is forced to pass through the flame. In the urn, A, is a contrivance to regulate the quantity of oil coming from it, that the lamp may not be overflowed: it unscrews at *t*, (fig. 2) and terminates below the screw in a small pipe, *v*, closed at bottom: a hole is made in the side of this pipe, through which the oil flows: it is closed occasionally by a small tube sliding upon the other, *v*, and moved by a small handle, *t*, coming through the screw, *t*: a small hole should be drilled through the

screw in the same direction as the wire of the handle, *t*, to supply air to this part. When the urn is to be filled with oil, it is unscrewed at *t*, and the oil poured in at the hole in tube *v*: the hole must then be closed, by pushing down the handle, *t*: the oil cannot now get out, and the urn is screwed into its place; when the handle, *t*, is pushed down the hole is opened, by removing the tube, *u*, from before the hole in the pipe, *v*: the oil now runs out, the air entering at the same hole, until it rises in the cistern at the end of the pipe, B, above the level of the hole; the air cannot now enter, and consequently the oil will not come out, until by the burning of the lamp the oil is drawn down below the hole, a bubble of air then gets into the urn, and an equivalent drop of oil runs down; by this means, though the lamp is always plentifully supplied, yet it never runs over.

LAMP *black*. See Colour.

LAMPYRIS, in natural history, *fire fly*, a genus of insects of the order Coleoptera. Antennæ filiform; four feelers; shells flexile; thorax flat, semi-orbicular, surrounding and concealing the head; segments of the abdomen terminating in folded papillæ: female usually apterous. There are nearly sixty species, in four divisions, *viz*. A. feelers subclavate: B. fore-feelers hatchet-shaped: C. feelers sub-filiform: D. first joint of the feelers thicker and truncate. The first of these divisions is subdivided into those which have entire horny lips; and into those with an emarginate membranaceous lip. The body of the insect in this genus is oblong, with the sides formed into a kind of soft papillæ, lapping over each other. L. noctiluca, or common glow-worm, is seen during the summer months, on dry banks, about woods, pastures, and hedgeways, exhibiting, as soon as it is dusk, vivid and phosphoric splendour, in form of a round spot of considerable size. The animal itself, which is the female insect, measures about three quarters of an inch in length, and is of a dull, earthy-brown colour on the upper parts, and beneath more or less tinged with rose colour, with the two or three last joints of the body of a pale or whitish sulphur colour. It is from these parts that the phosphoric light proceeds. The body, exclusive of the thorax, consists of ten joints. The larva and pupa do not greatly differ from the complete insect, but the phosphoric light is strongest in the complete animal. The male is smaller than the female, and is provided with wings and wing-sheaths: it is very uncommon; and it is not determined whether it be luminous or not. Naturalists have commonly supposed, that the splendour of the female is designed for the purpose of attracting the male. In Italy, the flying glow-worm is extremely common; and it is said that, on grand occasions, ladies use them as ornaments for their head-dress in evening parties.

LANA, in botany, *wool*, a species of pubescence, down, or velvet, which serves to screen the leaves, covered with it, from the heat: this appearance is very conspicuous in the horehound, woolly thistle, &c.

Lana *philosophica*, flowers of zinc. See Zinc.

LANARIA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Ensatæ. Irides, Jussieu. Essential character: corolla superior, woolly, longer than the filaments; border six-parted, somewhat spreading; capsule three-celled. There is but one species, *viz*. L. plumosa, woolly lanaria, a native of the Cape of Good Hope.

LANCET, a chirurgical instrument, sharp-pointed, and two-edged, chiefly used for opening veins in the operation of phlebotomy, or bleeding; also for laying open abscesses, tumours, &c.

LANGUAGE. 1. Man, it has frequently been said, is the only animal possessed of speech, and if we use this term as implying the expression of a train of ideas by articulate sounds, it may perhaps be esteemed the best criterion of distinction between man and the inferior animals. It is not easy to fix upon one which shall be universally applicable; but the same difficulty frequently occurs in the attempt to ascertain the exact boundary between the characteristics of one class of being and those of another: for instance, the naturalist finds it a puzzling problem to ascertain the characteristic difference between the animal and the vegetable kingdom. Some of the most intelligent of the brute creation often astonish us by actions which can proceed only from powers of intellect similar to those which we possess. All the mental powers, except sensation, are probably the modifications of the principle of association: it is acknowledged that brutes possess this in a considerable degree, and it is probable that to the difference in the extent of this principle of its activity and direction, we are to attribute the mental difference between one animal and another. There is, perhaps, less difference

between the most uninformed mind of the human species and the most sagacious of the brutes, than between the brightest ornaments of our race and those whose minds have received the least culture from natural or artificial education. We gain greater exactness by making the capacity of speech the criterion of distinction between man and the brute creation. Many animals are capable of acquainting others of the same, and even of a different species, with the feelings of their minds; but man alone has the power of expressing a train of ideas, and of stating the causes of those feelings.

2. Articulation furnishes the most convenient and extensive method of communication. It would be possible to form a language of signs, and in many instances this is done; but human thought would never have acquired any high degree of accuracy and extent, if there had been no other language. The most perfect language of signs is merely a representative of the language of speech. What are called the natural signs of feeling are very similar to the language of brutes, and not more extensive. To give speech all the energy of thought, the language of tone and gesture must be joined to it; but it will generally be found that those who have words for all their ideas, seldom have recourse to gesticulation, except when the warmth of feeling calls it forth. Where speech is defective in energy, it is usually enforced by looks, gestures, and tones: these powerfully appeal to the feelings, because they are considered as an indication that certain feelings exist in the mind of the speaker, and feeling is contagious; but our limits will not allow us to enter into the consideration of this species of language, and we shall confine ourselves to that of speech, at the same time begging our readers to refer to the article VOICE for an account of the mechanism by which speech is effected, and to WRITING, *origin of, alphabetical*, for the methods which men have adopted for a permanent visible denotement of speech, which latter we wish to be considered as forming one with the present article.

3. Whatever be our opinion respecting the progressive melioration of brutes, if the capacity of language were communicated to them, there can be no hesitation in admitting that there would be a progressive deterioration of the human species, if they were deprived of it. Had not man possessed this, or some other extensive power of communication, that astonishing system which we call the human mind, would have remained in inactivity, its faculties torpid, its energies unexcited, and that capacity of progressive improvement which forms so important a part in the mental constitution would have been unknown and given in vain. But in every part of the creation we discern an unity of design which equally proves the wisdom and benevolence of the great First Cause. The means of bringing his powers into activity are bestowed upon man, as well as the powers themselves; and it is a position which will bear a rigorous examination, that the accuracy of human thought, and the extent of human intellect, generally proceed in equal steps with the accuracy and extent of language. When we consider the influence of language upon intellect, it will not appear too much to affirm that, if those whose genius has dazzled the world with its splendour and extent, had been from the first destitute of the power of communication, they would not have risen above the level of the least cultivated of their fellow mortals. "Conceive such a one (to use the ideas of Condillac) bereft of the use of visible signs, how much knowledge would be concealed from him, attainable even by an ordinary capacity. Take away from him the use of speech, the lot of the dumb teaches you in what narrow bounds you enclose him. Finally, deprive him of the use of all kinds of signs, let him not know how to make with propriety any gesture, you would have in him a mere idiot."

4. We are far, however, from believing, with Lord Monboddo, that the human race have actually risen from the very lowest stage—that of mere brutality. His lordship supposes, on the authority of several travellers whom he quotes, (and of whose passion for the marvellous his quotations leave no room to doubt), that there have been nations without laws or any of the arts of civilized life, without even language; and that some of them (to complete their resemblance to the monkey tribe) had actually tails. This, with other opinions which display rather the credulity of the man of system, than the sober and cool judgment of the philosopher, has exposed his lordship to the lively ridicule of Mr. Horne Tooke; and though ridicule is no test of truth, we must admit that this is one of those dogmata which it is below the dignity of reason to refute.

5. We see in language a complicated whole, which we are usually accustomed to

consider as it is, without attempting to ascertain what it has been. We see all regularity and beauty, and we do not often ask ourselves the question, has language always been thus regular and beautiful? When we look back into the earlier periods of human nature, we find that this which now wears so much the appearance of art, was originally the invention of necessity, gradually perfected and brought into a systematic form by causes which have operated generally, but have received modification from the influence of local or temporary circumstances. A complete history of the origin and progress of language, would be a history of the human mind. Our direct evidence is not very extensive, and indeed we are too much obliged to have recourse to hypothesis in tracing the progress of improvement in any department of science. We are unable always to ascertain (as Mr. Stewart observes) how men have actually conducted themselves on particular occasions, and we are then led to inquire in what manner they are likely to have proceeded, from the principle of their nature, and the circumstances of their external situation. In such inquiries the detached facts which the remains of antiquity, or the narrations of travellers, or the actual appearances of language at present, afford us, serve as landmarks for our speculations. "In examining the history of mankind, as well as in examining the phenomena of the material world, when we cannot trace the process by which an event *has been* produced, it is often of importance to be able to show how it *may have been* produced by natural causes. The steps in the formation of language cannot probably be determined with certainty; yet if we can show from the known principles of human nature, how all its various parts might gradually have arisen, the mind is not only to a certain degree satisfied, but a check is given to that indolent philosophy which refers to a miracle whatever appearances both in the natural and moral worlds it is unable to explain."

6. Diodorus Siculus and Vitruvius supposed, that the first men lived for some time in the woods and caves, like the beasts, uttering only confused and inarticulate sounds; till, associating for mutual assistance, they came by degrees to use articulate sounds, mutually agreed upon, for arbitrary signs or marks of those ideas in the mind of the speaker, which he wanted to communicate to the hearer. By what degrees they proceeded from inarticulate to articulate sounds, these writers do not attempt to point out, and unless we admit that those articulate sounds were connected with certain feelings, in the same manner as what are called the natural signs, or, that they were easily produced, (which will not be allowed by any who have attended to the structure of the organs of speech) the account we have received from a better informed historian will not lose its ground. Moses leads us to understand that the rudiments of language were given to man by his Maker. Here was the first step, and here it is reasonable to believe the divine communications ceased, and that man was left to complete what he had been taught to begin. Let us then suppose the use of articulation given, and its application in some instances pointed out, in the invention of the names of animals; which, we may observe, is in fact the first step which would probably have been taken, presupposing the use of articulation, if no divine interposition had taken place.

7. Words would originally be simply the signs of things, and further, of individuals. New objects, for which necessity required a name, would receive different names from those already given; but if there were a striking similarity between a new object, and one which had already received a name, the old name would be transferred. One of the principles of association is similarity, and the new impression would recal the idea of a former object which it resembled, and consequently the word with which that object was connected; and thus, what originally was a name for an individual only, would gradually become the name of a multitude. Thus Lee Boo, who had been taught by his fellow voyagers to call a great Newfoundland dog by the name of *Sailor*, used to call every dog he saw *Sailor*. There is little or no difficulty attending the appellation and classification of sensible objects: it is an operation simple and easy, if some articulate sounds were known.

8. When several objects had received the same name, it would sometimes be necessary to distinguish them. Our procedure in such cases is to connect with the name of the object the name of a distinguishing quality, or some word of a restrictive force, or to specify some relation which it has with other objects; but this supposes that to be already done, which we must suppose is to be done. Now we must bear in mind that similarity (sensible, ex-

ternal similarity) and local connection, are those principles of association which are known to be most active in the minds of the illiterate and uncultivated, and that they must also have been the most active in the minds of all men in the rude states of society. A peculiar colour (which would furnish one criterion of distinction) would, therefore, suggest the idea of some object remarkable for that colour; and the name of this second object, joined with the name which the first had in common with others, would confine this general term to the particular object which it was intended to specify. This is a procedure so simple, that we may expect to find some traces of it still remaining to us; and accordingly, among others, we have the expression, *an orange ribbon*, which will exemplify what has been said: if we wish to distinguish a ribbon by its colour, we are in this case able, agreeably to the custom of our language, to connect with the word ribbon, the name of an object remarkable for that colour. It must however be observed, when tracing out other examples of this contrivance, and the application of it to other qualities, that *sensible* qualities were those, and those only, which would be first noticed and most requisite to be noticed. Local situation, or vicinity to some object, would furnish another ground for distinction; the fountain near the cave, for instance. Now to express this, the procedure would be simple and intelligible if, immediately preceding or following the term denoting *fountain*, the term denoting *cave* were added; in like manner as we at present use the expressions, *barn-yard*, &c. This juxta-position of the signs to signify the contiguity or similarity of the objects which they denote, is natural, and, in a language little extended, sufficiently adequate for all the purposes of common life: but it is obvious that it would allow of great latitude of interpretation; and hence as languages became more copious, contrivances were used to denote the nature of the connection which existed between objects denoted by the signs employed. The chief of these is the employment of prepositions; and these, in the outset, furnish additional proof that the procedures we have spoken of were in reality those of the early framers of language, see GRAMMAR, § 41, particularly respecting *from*); but these were contrivances of a later date than those of which we here speak. By degrees it was by some tribes found convenient to designate those names which were employed in connection with other names to point out some quality or restricting circumstance of the thing signified, by some note that they were so employed. They might without any disadvantage have left the inference to simple juxta-position; but this appears to have been done in few languages after improvements began to take place: and to effect such designation, words (in some cases denoting *add*, *join*, &c.) were subjoined to the particularizing names, and they then became adjectives. (See GRAMMAR, § 22.) The Chinese, however, make no distinction between words when employed as nouns and as adnouns; the same word when placed first being an adjective, and when placed last, a substantive. We do the same in many instances; but a large proportion of our simple adjectives are formed as above, and are never employed as substantives: the Chinese, on the other hand, when a substantive is not to be used adjectively, add a designating syllable to it.

9. As far as respects sensible objects and their connections, all seems very plain: in order to express objects which were not sensible, so as to convey to others the feelings which existed in the mind of the speaker, words were used which had previously been appropriated to objects, to which those objects of the mind's eye appeared to have some resemblance or other connection. This resemblance or connection was frequently forced, and to those whose situation was different would not be at all striking: in other cases it was correct, and the justness of the application is proved by a similar procedure of unconnected inventors. We may derive great light here from the hieroglyphics; for there cannot be a doubt that where the visible sign, which originally represented only a sensible object, was applied to denote some quality discovered by reasoning and observation, that the audible sign or word was applied in like manner. Several instances will be adduced when we come to consider the hieroglyphical mode of communication: at present we shall adduce one or two examples as illustrations of the principles here stated. The term used to denote the *mouth* would also denote *speech*; this connected with the word *dog*, would signify the *dog's voice*; and this compound the Egyptians employed to signify *lamentation*, and the *sorrow* which produced it. In the uncultivated periods of society grief is loud and clamorous; and we need not be

surprised to find the term *howl* employed to denote the exclamations of pain, and even of sorrow. By a similar, but more obvious procedure, the words *dog*, *field*, placed together, denoted *hunting*. Our readers will be able, even in the present refined period of our language, to trace numerous instances in which the names of intellectual things have been obviously transferred from sensible things; and to those who have attended to the subject it will not appear too much to affirm, that in every instance where a word is not the name of a sensible object, it has acquired its present force by a gradual transition from its primary application to sensible objects. In every known language the transition has been begun; but it is only among the more refined that it has been complete: in our own, we find abundance of instances in almost every intermediate stage of the progress, as well as in its termination.

10. Language would proceed but awkwardly without those wheels which have been gradually made for it; but all which can be thought necessary for communication, are the noun and the verb; and even of the latter the necessity may be justly doubted. We think it next to certain that the whole of what is now (by association) implied or denoted by the verb, beyond what is denoted by the acknowledged noun, was originally mere inference from the juxta-position of the verb-noun with another noun. *Men fight* are names, and are still acknowledged as such; placed together, especially if accompanied by distinguishing tones of voice, it would be naturally inferred that the speaker intended to raise in his hearer's mind that belief which exists in his own; in other words, to direct his hearer to make a connection which circumstances has formed in his own mind. By degrees, at least in some nations, some of those names which were frequently thus employed with the inference of affirmation, became somewhat appropriated to convey this inference, and the inference would then be made whenever such a word was employed; but in the earliest stages of language, the great body of verbs must have been merely nouns, and in the more simple languages many of those words which are employed as verbs (*i. e.* conveying the inference of affirmation) are still immediately recognised as nouns. In the Chinese very few names are appropriated as verbs, but are used indiscriminately, and without any change of form, either as nouns or as verbs: in the Hebrew, the root (which does not, like every part of the indicative in the Greek and Latin verbs, include a pronoun) is a simple name, and is in many cases used as a noun; and in our own language many names are used either as nouns or as verbs. When we have advanced to the frequent use and gradual appropriation of some names to convey the inference of affirmation, the rest is easy and almost certain. With respect to the simple affirmation, the subject of it would, in the case of the first and second persons, always be a pronoun, and, in the same district, the same pronoun. This, where *spoken* language made material progress, would gradually coalesce with the verb; and the word so formed would be completely invested with the verbal character, and never be employed but with the inference of affirmation. The same might also be the case respecting the third person, but the coalescence would in this instance be more slowly formed, and in some languages where the coalescence took place in the other persons it did not in this: it must however be admitted that in others the contrary is the fact. But we have already enlarged on these points as much as our limits will permit; and we therefore beg our readers to refer to GRAMMAR, § 29, 33, for some additional remarks respecting those changes which the verb has undergone in order to make it more expressive.

10. We do not think it necessary to enter any farther into the subject of the origin of oral language. It can scarcely be doubted by those who have studied the nature of the other parts of speech by means of the light which the researches of Mr. Tooke have afforded, that all have been derived from the noun and the verb: and admitting this, all that is incumbent upon those who profess to show the original causes of language is to present a probable origin of those classes of words. In those procedures which have been here stated, there is nothing which supposes metaphysical research or much observation; and to render any procedure probable, it must wear the marks of simplicity. In the present period of the language, we see the grammarian pointing out the analogies which are found to exist in language, and thence proceeding to the formation of new words upon those analogies: this is art; but the early formers of language, in their inventions followed only the dictates of circumstances, and whatever regularity we may perceive in their inventions, must be

attributed to the similarity of those circumstances. We see the philosopher inventing a new term, agreeably to prevailing analogies, to express some power of the mind, or some emotion which had not received any denomination; but those who originally gave names to mental feelings derived them simply from some analogy, fancied or real, between the internal and an external object: and those names which now suggest to us ideas the most subtle and refined, were originally only the names of objects obvious to the senses. The reasoner when he uses a word whose meaning has not been accurately ascertained, defines the ideas which he intends to attach to it, and uses it accordingly: in the early, and even in the more refined periods of language, the ideas connected with words have been the result of casual associations, produced by local circumstances, by the customs of the age, or the appearances of nature in particular situations.

11. In languages in which the coalescence between the verb and its adjuncts has taken place, and also the coalescence between nouns and its connective words, (Grammar, § 19), much greater liberty of inversion is practicable than in those in which such coalescence has not at all occurred, or but incompletely. In other words, where the noun, adnoun, and verb, admit of flexion, there the arrangement depends in many instances more upon the sound than upon the sense; and nearly in all cases may be made subservient to the former. This gives such languages considerable advantage over those which admit of but few changes, so far as respects their modulation; and further the coalescence renders them much more forcible where emphasis on any of the fractional parts is not required. Whenever flexion increases perspicuity, the advantage is decisive and obvious: with respect to modulation, though an object of some consequence, (since we may sometimes find the way to the head and heart by pleasing the ear) yet all cultivated languages will be found to possess sufficient power of pleasing the native ear; and among those who made sound so much an object, sense was often sacrificed to it: with respect to force, it may fairly be doubted whether the advantage of greater precision by means of more accurate emphasis, does not counterbalance it. We are willing to admit on the whole, that the advantage is somewhat in favour of those languages in which flexion is extensively adopted; but we can by no means admit the opinion of those who think it necessary to a perfect language. That language is not the most perfect, which enables us to express one thought in a great variety of ways, but that which enables us to express any thought with precision and perspicuity: and contemptible as our own uninflected language may appear to those who can think nothing good but what accords with the objects of their early taste, we are disposed to believe that in its real powers it rises beyond all the ancient languages, and beyond most of the moderns.

12. Before we leave the subject of oral language, we shall pay some attention to the three following inquiries; whether words were originally imitative; whether they were long; and of what kind of articulations they were composed. The latter of these are of importance in tracing the gradation from hieroghyphical to alphabetical writing. Words, in their present state, are simply arbitrary marks. The sound of some appears to be "an echo of the sense;" but in the greater number of instances in which there is supposed to be this resemblance, very much may be attributed to the fancy of the observer. It is obvious, however, that some words are truly imitative, such *e. g.* as denote the various sounds of animals. When we carry our inquiries farther back, we are led to suppose that the original words would be formed upon some resemblance, real or supposed, between their sound and the thing signified. What else, at first, could induce men to fix upon one sound rather than another? Sensible objects were the first which obtained names; and of these the number is considerable which either emit some imitable sound, or perform such motions as are generally accompanied with sound. These would probably be denoted by words imitative of the sound, in the same manner as the Otaheitans gave to the gun the appellation of *tick-tick-boo*, evidently imitating the cocking and report of the gun, and as we give the *cuckow* its name from its note. With respect to qualities totally unconnected with sound, particularly mental qualities, this principle of imitation is not directly applicable: we immediately see the incongruity of sound and colour, for instance, when we call to mind the idea of the blind man, that a scarlet colour was very much like the sound of a trumpet. Yet there can scarcely be a doubt that *fancied* resemblances would as much as real ones, direct

the application of names. Some ingenious writers on this subject have observed certain letters applied to denote a certain class of ideas, which have some common features of resemblance, and have inferred that those letters were *significant* of that common feature; *e.g.* that *c* denotes *hollowness.* This particular coincidence arises probably from the circumstance, that the original word denoting hollowness, which has entered variously modified into the words in question, was *c* with some vocal sound. This appears to be the extent of the inferrence which may be justly drawn; that it was so applied, but not that the sound was significant of the idea. We are accustomed to use sounds in particular connections with such regularity and constancy, that they appear to have a signification of themselves considered; but this inference arises from inattention to the matter of fact. Frequently from our acquaintance with the sense, we read a combination of words as the sense dictates, and suppose the imitation in the words, which really exists only in our mode of enunciation; but these instances, however just, afford no ground for argument in the present discussion, which refers only to single words: and with respect to them we cannot but confine the resemblance of their sound to their sense, to cases in which they denote sound or motion usually accompanied with sound.

13. The chief importance of the inquiry whether the original words of language were long, is principally confined to that language in which the transition took place from hieroglyphics to letters. This is usually supposed to have been the Egyptian; but as of this language only a few words are preserved in the Coptic, (of which however a large proportion are monosyllables) we may make the inquiry more general. Lord Monboddo supposes, that the first articulate sounds were imitations of the cries of animals, and that consequently they were of great length, "for such cries of almost all animals have a certain tract or extension: and that we may not think man an exception to this rule, we need only attend to the dumb persons among us, who utter inarticulate cries, sometimes very loud, but always of considerable length." Leaving the latter argument, which surely is nothing to the purpose, we may observe, that if the cries of animals were imitated to denote those animals, great length of words was unnecessary and improbable: unnecessary, because one or two distinct articulations would usually answer every purpose; improbable, because articulation is difficult. If we extend the principle of imitation farther, and suppose the cries of animals imitated by man in order to express feeling merely, his cries would surely be undeserving the name of words, and at any rate would throw no light on our inquiries. The theory of long words appears to derive confirmation from the vocabularies of the North American Indians. For instance, of three which are given by Mackenzie, two appear to be composed of words of from two to seven syllables, with scarcely any words of one syllable. The third, however, is composed principally of words of one or two syllables. With respect to the former, even where the words actually denote sensible objects, our inference that they are uncompounded should be cautiously drawn. The moon is expressed by two words, *tibiscapesim, night-sun;* and several others appear to be circumlocutions. The catholic savages on the river St. Lawrence call the priest, *the master of life's man;* and it is very probable that, in uncultivated nations, names of new objects would, where possible, be formed rather by significant combinations of words in use, than by the formation of new words. Thus we learn from Mr. Parke, that the Mandingo nation use the following (among many) circumlocutions: *fruit* is eree-ding, *child of the tree; finger,* boullakon ding, *child of the hand or arm; noon* teeleekoniata, *the sun over head; brother,* ba ding kea, *mother's male child; proud,* telingabalid, *straight-bodied; angry* jusu bota, *the heart comes out:* we think it almost unnecessary to remark, how much the last two instances countenance the positions before laid down, respecting the transference of names from external to internal things.

14. The words which Lord Monboddo adduces in proof of his opinion are, wonnaweucktucklnit, *much,* and mikkeuawkrook, *little,* from the Esquimaux; and poellarrarorincourac, *three,* among some South American Indians. The above examples lead us to class the two former among the descriptive circumlocutions with which all languages are filled. With respect to the last, we may observe that the names of numbers were probably originally significant in all languages; and that the length of those names would depend upon the length of the original words, and the manner of combining them: thus, six is among

the Kamschatkans expressed by *innen- mil-chin*, that is, *five and one*. Numbers are so familiar to us, and so distinctly arranged in groups, that perhaps in no case are our ideas more clear; but this clearness entirely depends upon the distinctness of the signs, and of the manner of using them. We speak of ten and twenty, &c. and all seems very clear; but it is evident if we attempt to form a conception of ten or twenty things, we must pass over every one singly, and endeavour to combine them by processes which will be varied by the habits of the individual. If we give a fresh name to every group of objects, and then consider those groups as units, and so on, we are capable of extending our ideas of number indefinitely, and of speaking and thinking of them with accuracy: but if the small extent of intellect, or the circumstances of situation, prevents this grouping, and our attention be confined to individuals, our arithmetic must be very confined. Those nations which reckon only by comparison with their fingers without grouping numbers, carry their ideas of number no farther than ten; those who take in the toes, go as far as twenty. The Kamschatkans can count no farther; and when they have advanced to this limit, they say, "where shall we go now?" It is difficult to conceive what circumstances could bound the arithmetic of Lord Monboddo's Indians to three, or rather what should induce them to choose so troublesome a mode of procedure; but it appears highly probable that they joined together the names of three different men or other animals, and if they had proceeded further (which however Condamine informs us they did not) they would have joined four together, &c. Perhaps their tribe originally consisted of three only; and then in order to speak of three they might use the three names combined together, which combination, losing its primary application, would become a general denotement of three.

15. If Lord Monboddo had looked into the vocabulary of the Mexicans, he would have thought that his theory derived great confirmation from their words. Clavizego informs us, that they had words of fifteen or sixteen syllables: but he expressly says they are compounds. He gives one as a specimen of their combinations, *viz.* notlazomahuitzteopixcatalzin: this signifies *my very worthy father* or *revered priest*, and is compounded of seven words. The language of the Mexicans is very copious; and one cause of the length of their words is probably the deficiency of consonants, which renders a combination of sounds necessary for distinctness. After all, we may admit that the languages of the American Indians favour the hypothesis of long words without any injury, for among them alphabetical writing never existed; and we should have enlarged less on this point, if it had not led us to notice some curious procedures of language: but it seems reasonable to admit, as an inference, that the original or rather the secondary words in language might be long, though not to the degree that Monboddo supposes. When, however, we advance further, and inquire of what kind the original words of man really were, we see sufficient reason to conclude them to be short. Language was first used in the east, and there too writing was invented. Besides the evidence to be derived from the ancient Egyptian (§ 13), we may cite the following. The Chinese, which as far as oral language is concerned, appears to have undergone very little alteration, and to be nearly an original language, is composed entirely of what are at present monosyllables. The original words of the Hebrew, Greek, &c. (that is, those which have not been varied by the addition of other words) are short, frequently only of one syllable, seldom of more than two. And to conclude, of the various vocabularies which we have had an opportunity of consulting, of the uncivilized nations of the east, the words are generally monosyllabic, or dissyllabic.

16. Our last object is to consider the position, that, in the early languages, consonant sounds were at least generally accompanied by vowel sounds: but though this is a material point in tracing the transition from hieroglyphics to alphabetical writing, it will not be necessary to enlarge much upon it. We think this position proved by the following, in some measure unconnected, considerations. 1. Vowel-sounds are by far the most easy; and consequently they constitute the earliest vocal sounds of children, and a large proportion of the vocal sounds of uncivilized nations. Several words among the South Sea islanders are composed entirely of vowel sounds; and so great is the difficulty which these people find in pronouncing consonants together, that they called Sir Joseph Banks, *Opano*. From this consideration we may fairly infer, that vowel sounds would be frequent in the original words of the early

languages, which were formed before articulation was become easy. Yet 2, as the shades of distinction between them, when employed alone or together, are too nice to furnish, at least to the unpractised ear, many obviously different words; and as man was not at first in that low state of intellect in which he has sometimes appeared, a vocabulary formed of such sounds would be very inadequate to his wants; and therefore we must suppose that in the early languages there would be very few words without consonant sounds. 3. Some of the first articulations of man were, without doubt, employed in naming those of the inferior animals with which he was concerned. Now their names would almost certainly be given from their distinguishing cries; and the cries of such animals consist of consonant sounds, each followed by a vowel sound. 4. As articulation would at first be nearly as difficult as we now perceive it to be in children, the first words would be composed of simple articulations, that is, of consonant sounds following each by a vowel; and new words would be formed by the combination of such words: so that in the early languages all compounds would be formed by the combination of simple articulations. 5. The greater part of consonant sounds cannot be sounded singly without vowels, nor together, without vowels intervening. In many cases this is evident to the ear; and where it is not perceived, it often is the fact, though the acquired rapidity of utterance may render it very little perceptible. 6. Some languages do not admit of any two consonant sounds together. The Tartar language always requires a vowel between two consonants. The Russian, we believe, does the same. The Chinese never join two consonants, unless we must except *ng*; but this appears to be only a simple sound, though represented by two of our letters. With respect to the Chinese the point is of consequence; because there is great reason to believe that they came from the stock of the Egyptians, before there had been any considerable addition to their vocabulary by combinations of sounds, and before the transition had been made from hieroglyphical to alphabetical writing. It is true many of the Chinese words end in consonants, which seems to render improbable the position advanced: but it is to be observed that in such cases the words should be considered as of two syllables; for it is impossible, in continued speaking, to utter a complete consonant sound at the end of a word, without emitting a vowel sound. 7. That the Hebrew, which is to be considered as a representative of all the cognate eastern languages, never sounded a consonant without a vowel, may be inferred from this circumstance, that those who invented denotements of vowel sounds, while at least the leading features of the pronunciation remained, thought it necessary to add, or suppose understood, a vowel sound after every consonant.

Respecting the Chinese language our readers will find many particulars in the article before referred to, *viz.* WRITING, *origin of, alphabetical.*

LANIARD, a short piece of rope or line fastened to several machines in a ship, and serving to secure them in a particular place, or to manage them more conveniently; such are the laniards of the gun-ports, the laniard of the buoy, the laniard of the cat-hook, &c.

The principal laniards used in a ship are those employed to extend the shrouds and stays of the masts by their communication with the dead-eyes and hearts, so as to form a sort of mechanical power, resembling that of a tackle.

LANIUS, the *shrike*, in natural history, a genus of birds of the order Picæ. Generic character: bill straightish, with a tooth or notch near the end of the upper mandible; the tongue jagged at the end; outer toe connected with the middle one so far as the first joint. These birds are ranked by Gmelin with the Accipitres, and have been by others placed in the order Passeres; according to Kramer, Scopoli, and Pennant, however, they most appropriately attach to the Picæ. There are, according to Gmelin, fifty-six species. Latham enumerates forty-nine, of which it will be sufficient to notice the following: L. excubitor, the great shrike, is about the length of ten inches, and found in France in great numbers, but rare in England. It subsists on insects and small birds, seizing the last by the throat and strangling them, and then fixing them on a thorn, from which it tears them piecemeal and devours them. To decoy them within its reach it imitates the songs of many birds, which approach, delighted by the sounds, and unsuspicious of the danger. It is a favourite bird with husbandmen, as it is considered by them a mortal enemy to rats, mice, and other species of vermin. It, however, prefers mountainous and secluded situations to the neighbourhood of mankind.

It appears contented in confinement, but is completely silent in it with respect to any song. It may often be perceived to hang its food, before devouring it, on the wires of its cage. See Aves, Plate VIII. fig. 4.

L. colluris, or the red-backed shrike, is much more frequently to be met with in this country than the last species. It is particularly fond of grasshoppers and beetles, which, as indeed various other articles of its food, it will stick upon a thorn. The manners of this species and the last are, in fact, extremely similar. It imitates the sounds of other birds to decoy them to destruction. During incubation, the female discovers herself to any person approaching her nest by violent clamours of alarm. In St. Domingo there is a species of these birds daring in the extreme, particularly in the breeding season, in which they will attack every bird that approaches, without hesitation or distinction. In Carolina there is another species equally intrepid and ferocious. They will assail the crow, and even the eagle if it attempts to intrude upon their premises, collecting in considerable numbers against the aggressor, and seldom failing to make him repent of his temerity. These are denominated the tyrants of Carolina.

LANTANA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Vitices, Jussieu. Essential character: calyx obscurely, four-toothed; stigma hook, refracted; drupe with a two-celled nucleus. There are nineteen species. These are mostly shrubs, very few being herbaceous. The branches are quadrangular; the leaves opposite, in pairs, except in a few cases, where there are three or four together, ovate and wrinkled; flowers aggregate, in axillary and peduncled heads, each flower bracted.

LANTERLOO, or Loo, a game at cards, played several ways, whereof we shall only mention two.

The first way is this: lift for dealing, and the best put carries it: as many may play as the cards will permit; five being dealt to each, and then turning up trump. Now, if three, four, five, or six play, they may lay out the threes, fours, fives, sixes, and sevens, to the intent they may not be quickly looed; or if they would have the loos come fast about, then they are to play with the whole pack.

Having dealt, set up five scores, or chalks. Then ask every one, beginning with the eldest in hand, whether they will play, or pass from the benefit of the game; and here it is to be observed that the cards have the same values as in honours. You may play upon every card what sum you please, from a penny to a pound; and if looed, that is, win never a trick, you must lay down to the stock so much for your five cards, as you played upon every one of them. Every deal rub off a score, and for every trick you win set up a score, till the first scores are out; then counting your scores, or the numbers of the tricks you have won, you are to take from the stock in proportion to the value. A flush, or five cards of a suit, looes all the other hands, and sweeps the board; and if there be two flushes, the eldest in hand hath the advantage: the knave of clubs, called paam, has this privilege, that he makes a suit with any other cards, and saves the person who has him from being looed.

The other way is this: the dealer lays down so much for every card as the company please to play for; and the cards being dealt, all must play; if any be looed, they must each lay down so much as the cards are valued at, for their loo; and if the person next dealing be looed, he must lay down double the said sum, *viz.* one for dealing, and the other for his loo. In case of a loo, the gamesters are asked whether they will play or not, beginning at the eldest hand; but if there is no loo they must all play as at first; and this necessity they justly call force.

If there be never a loo the money may be divided by the gamesters, according to the number of their tricks, or left till one be looed, as they shall judge proper.

LANTERN, *magic*, an optic machine, whereby little painted images are represented so much magnified as to be accounted the effect of magic by the ignorant. See Optics.

The contrivance is briefly this: A B C D (Plate VIII. Miscel. fig. 1.) is a tin lantern, from whose side there proceeds a square tube *b n k l m c*, consisting of two parts; the outermost of which, *n k l m*, slides over the other so as that the whole tube may be lengthened or shortened by that means. In the end of the arm, *n k l m*, is fixed a convex glass, *k l*; about *d e* there is a contrivance for admitting and placing an object, *d e*, painted in dilute and transparent colours, on a plane thin glass; which object is there to be placed inverted. This is usually some ludicrous or frightful representation, the more to divert the spectators;

b h c is a deep convex glass placed in the other end of the prominent tube, the only use of which is to cast the light of the flame, *a*, strongly on the picture, *d e*, painted on the plain thin glass. Hence, if the object, *d e*, be placed further from the glass, *k l*, than its focus, it is manifest that the distinct image of the object will be projected by the glass, *k l*, on the opposite white wall, F H, at *f g*; and that in an erect posture: so that, in effect, this appearance of the magic lantern is the same with that of the camera obscura, or darkened room; since here the chamber, E F G H, is supposed quite dark, excepting the light in the lantern A B C D. And here we may observe, that if the tube *b n k l m c*, be contracted, and thereby the glass, *k l*, brought nearer the object, *d e*, the representation, *f g*, will be projected so much the larger, and so much the more distant from the glass *k l*; so that the smallest picture at *d e* may be projected at *fg* in any greater proportion required, within due limits: whence it is, that this lantern got the name of *lanterna megalographica*. On the other hand, protracting the tube will diminish the object.

Instead of the convex glass to heighten the light, some prefer a concave speculum, its focus being nearer than that of a lens; and in this focus they place the candle.

LAPIDARY *style* denotes the style proper for monumental or other inscriptions; being a sort of medium between prose and verse. The jejune and brilliant are here equally to be avoided. Cicero has prescribed the rules of this style. "Accedat, oportet oratio varia, vehemens, plena spiritûs. Omnium sententiarum gravitate, omnium verborum ponderibus, est utendum." The lapidary style, which was lost with the ancient monuments, is now used in various ways, at the beginning of books; and even epistles dedicatory are composed in it, whereof we have no example among the ancients.

LAPIS *lazuli*. See LAZURSTEIN.

LAPIS *infernalis*. See LUNAR *caustic*.

LAPLISIA, in natural history, *sea-hare*, a genus of the Vermes Mollusca class and order. Body creeping, covered with reflected membranes, with a membranaceous shield on the back, covering the lungs; aperture placed on the right side, vent above the extremity of the back; four feelers, resembling ears. There are two species, *viz*. L. depilans; body pale-lead colour, immaculate, it inhabits the European seas; from two to five inches long; is extremely nauseous and fetid, and is said to cause the hair to fall off from the hands of those who touch it.

L. fasciata, black; the edges of the membranaceous covering, and of the feelers scarlet; it inhabits the shores of Barbary, among rocks; when touched it discharges a black and red sanies, which, however, is neither fetid nor depilatory like the last. It is frequently to be met with off Anglesea.

LAPPAGO, in botany, a genus of the Triandria Digynia class and order. Natural order of Gramina. There is but one species.

LAPSANA, in botany, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ, Semiflosculosi. Cichoraceæ, Jussieu. Essential character: calyx calycled; each of the inner scales channelled; receptacle naked. There are five species, of which L. communis, common nipple-wort, is very abundant all over Europe in hedges, shady, and waste places and cultivated ground; flowering in the summer months. Nature has amply supplied the want of that down to the seed with which most of this class are furnished, by the great abundance which every plant produces.

LAPSED *legacy*, is where the legatee dies before the testator, or where a legacy is given upon a future contingency, and the legatee dies before the contingency happens. As if a legacy is given to a person when he attains the age of twenty-one years, and the legatee dies before that age; in this case, the legacy is a lost or lapsed legacy, and shall sink into the *residuum* of the personal estate.

LARCENY is the felonious and fraudulent taking away of the personal goods of another, against his will, with intent to steal them. If the goods are above the value of 12*d*., it is called grand larceny; if of that value, or under, it is petit larceny: which two species are distinguished in their punishment, but not otherwise. The mind, or intention, of the act alone makes the taking of another's goods felony, or a bare trespass only; but as the variety of circumstances is so great, and the complications thereof are so mingled, it is impossible to prescribe all the circumstances evidencing a felonious intent, or the contrary.

As all felony includes trespass, every indictment must have the words feloniously took, as well as carried away; whence it follows, that if the party be guilty of no trespass in taking the goods, he cannot be

guilty of felony in carrying them away. With respect to what shall be considered a sufficient carrying away, to constitute the offence of larceny, it seems that any, the least removing of the thing taken, from the place where it was before, is sufficient for this purpose, though it be not quite carried off; but there must be a removal from the place, though it is put back again: and where a pack in a waggon was not actually moved away, but only turned up an end, in order to be carried off, it was held no felony.

As grand larceny is a felonious and fraudulent taking of the mere personal goods of another above the value of 12*d.*, so it is petit larceny, where the thing stolen is but of the value of 12*d.*, or under. In the several other particulars above mentioned, petit larceny agrees with grand larceny; but in a petit larceny there can be no accessaries either before or after.

Larceny from the person. If larceny from the person be done privily without one's knowledge, by picking of pockets or otherwise, it is excluded from the benefit of clergy, by 8 Elizabeth, c. 4, provided the thing stolen be above the value of 12*d.*; but if done openly and avowedly before one's face, it is within the benefit of clergy.

Larceny from the house. By the common law this was not punished otherwise than as a simple larceny, except in the case of burglary, which is a breaking into a house in the night-time, with intent to steal, and punished capitally; but now, by several statutes, stealing in a house is deprived of the benefit of clergy in almost every instance. As, first, in larceny above 12*d.*, in a church or chapel, without violence or breaking the same. Secondly, in a booth or tent, in a fair or market, by day or night, by violence or breaking the same, the owner or some person of his family being therein. Thirdly, by robbing, which implies breaking into, a dwelling-house in the day time, no person being therein. Fourthly, in the same, by day or night, without breaking, any person being therein, and put in fear. Secondly, in larcenies to the value of 5*s.*, committed, first, by breaking any dwelling-house, or out-house, shop, or warehouse, no person being therein in the day time. Secondly, by privately stealing in a shop, warehouse, coach-house, or stable, by day or night, though the same be not broken open, and no person being therein. Lastly, in larcenies to the value of 40*s.*, from a dwelling-house or its out-houses, although the same be not broken, and whether any person be therein or not, unless by apprentices under fifteen against their masters.

Every person who shall be convicted of the feloniously taking away in the day-time any money or goods of the value of 5*s.*, in any dwelling house or out-house thereunto belonging, and used to and with the same, though no person be therein, shall be guilty of felony, without benefit of clergy. 39 Elizabeth, c. 15.

Receiving stolen goods. Any person who shall buy or receive any stolen goods, knowing them to be stolen; or shall receive, harbour, or conceal any felons or thieves, knowing them to be so, shall be deemed accessary to the felony; and being convicted on the testimony of one witness, shall suffer death as a felon convict; but he shall be entitled to his clergy. 5 Anne, c. 31. Any person convicted of receiving or buying stolen goods, knowing them to be stolen, may be transported for fourteen years. 4 George I. c. 11. Where the principal felon is found guilty to the value of 10*d.*, that is, of petit larceny only, the receiver, knowing the goods to have been stolen, cannot be transported for fourteen years, and ought not to be put upon his trial. For the acts which make receivers of stolen goods, knowingly, accessaries to the felony, must be understood to make them accessaries in such cases only, where, by law, an accessary may be; and there can be no accessary to petit larceny.

Every person who shall apprehend any one guilty of breaking open houses in a felonious manner, or of privately and feloniously stealing goods, wares, or merchandizes, of the value of 5*s.*, in any shop, warehouse, coach-house, or stable, though it be not broken open, and though no person be therein to be put in fear, and shall prosecute him to conviction, shall have a certificate without fee, under the hand of the judge, certifying such conviction, and within what parish and place the felony was committed, and also that such felon was discovered and taken, by the person so discovering or apprehending him; and if any dispute arise between several persons so discovering or apprehending, the judge shall appoint the certificate into so many shares, to be divided among the persons concerned, as to him shall seem just and reasonable. This certificate is commonly called a Tyburn ticket, and exempts the person from all parish and ward offices in

the parish where the robbery was committed.

With respect to the offence of larceny, it is difficult in so short a compass to define the particular distinctions which have been made; but it may be useful to mention some general particulars.

To constitute a larceny there must be a taking the goods without the consent of the owner; so that a fair loan, borrowing, or receipt of goods upon trust, which are afterwards converted, with intention to steal, to the use of the borrower, does not constitute a larceny or theft; but there are cases in which servants who have goods delivered to them, also apprentices, bankers clerks, and others, may be guilty of larceny; and there are others where the delivery of goods having been obtained by fraud, for the purpose of stealing them, a theft is held to be committed. A man may also be guilty of this offence, though the goods are his own, as where he steals goods from a pawnbroker, or other person who has a property in them for a particular purpose and limited time, with intent to charge him with the loss.

The felonious taking must also be from the possession of the owner; that is, either constructively or actually his possession; which may be where the thief has the actual possession, as a watch delivered for the purpose of being pawned. And the goods must be personal chattels, not such as savour of the realty, such as standing corn; but corn cut, or trees felled, are personal chattels, and may be the subject of larceny; and there are many statutes which make stealing certain articles, as lead, iron, and other things specified, affixed to the house or freehold, larceny. Bonds and bills were not such property as could be said to be stolen at common law, but they are made so by the statute law. And though it cannot be committed of vile animals which are wild by nature, yet the stealing of domesticated and tame animals is larceny, such as dogs, horses, fowls, and even hawks.

LARIX, in botany, the *larch-tree*, a species of Pinus. See the article PINUS.

LARK. See ALAUDA.

LARVA, in natural history. The larva state of insects, in general, denotes caterpillars of all kinds. The caterpillar state is that through which every butterfly must pass before it arrives at its perfection and beauty.

The change from caterpillar to butterfly was long esteemed a sort of metamorphosis, or real change of one animal into another; but this is by no means the case. The egg of a butterfly produces a butterfly, with all the lineaments of its parent; only these are not disclosed at first, but for the greater part of the animal's life they are covered with a sort of case or muscular coat, in which are legs for walking: these only suit it in this state, but its mouth takes in nourishment, which is conveyed to the included animal; and after a proper time this covering is thrown off, and the butterfly, which all the while might be discovered in it by an accurate observer with the help of a microscope, appears in its proper form. The care of all the butterfly tribe to lodge their eggs in safety is surprising. Those whose eggs are to be hatched in a few weeks, and who are to live in the caterpillar state during part of the remaining summer, always lay them on the leaves of such plants as will afford a proper nourishment; but, on the contrary, those whose eggs are to remain unhatched till the following spring, always lay them on the branches of trees and shrubs, and usually are careful to select such places as are least exposed to the rigour of the ensuing season, and frequently cover them from it in an artful manner. Some make a general coat of a hairy matter over them, taking the hairs from their own bodies for that purpose; others hide themselves in hollow places in trees, and in other sheltered cells, and there live in a kind of torpid state during the whole winter, that they may deposit their eggs in the succeeding springs at a time when there will be no severities of weather for them to combat. The day-butterflies only do this, and of these but a very few species: but the night ones, or phalenæ, all, without exception, lay their eggs as soon as they have been in copulation with the male, and die immediately afterwards.

Nothing is more surprising in insects than their industry; and in this the caterpillars yield to no kind, not to mention their silk, the spinning of which is one great proof of it. The sheaths and cases which some of these insects build for passing their transformations under, are by some made with their own hair, mixed with pieces of bark, leaves, and other parts of trees, with paper, and other materials; and the structure of these is well worthy our attention. Yet there are others whose workmanship in this article, far exceeds these. There is one which builds in wood, and is able to give its

case a hardness greater than that of the wood itself in its natural state. This is the strange horned caterpillar of the willow, which is one of those that eat their exuviæ. This creature has extremely sharp teeth, and with these it cuts the wood into a number of small fragments; these fragments it afterwards unites together into a case, of what shape it pleases, by means of a peculiar silk, which is no other than a tough and viscous juice, which hardens as it dries, and is a strong and firm cement. The solidity of the case being thus provided for, we are to consider, that the caterpillar inclosed in it is to become a butterfly; and the wonder is, in what manner a creature of this helpless kind, which has neither legs to dig, nor teeth to gnaw with, is to make its way out of so firm and strong a lodgment as this in which it is hatched. The butterfly, as soon as hatched, discharges a liquor which softens the viscous matter that holds the case together; and so its several fragments falling to pieces, the way out lies open. Reaumur judged, from the effects, that this liquor must be of a singular nature, and very different from the generality of animal fluids; and in dissecting this creature in the caterpillar state, there will always be found near the mouth, and under the œsophagus, a bladder of the size of a small pea, full of a limpid liquor, of a very quick and penetrating smell, and which, upon trial, proves to be a very powerful acid; and among other properties, which it has in common with other acids, it sensibly softens the glue of the case, on a common application. It is evident that this liquor, besides its use to the caterpillar, remains with it in the chrysalis state, and is what gives it a power of dissolving the structure of the case, and making its way through in a proper manner at the necessary time.

Boerhaave adopted the opinion that there are no true acids in animals, except in the stomach or intestines; but this familiar instance proves the contrary. Another very curious and mysterious artifice is that by which some species of caterpillars, when the time of their changing into the chrysalis state is coming on, make themselves lodgments in the leaves of the trees, by rolling them up in such a manner as to make themselves a sort of hollow cylindric case, proportioned to the thickness of their body, well defended against the injuries of the air, and carefully secured for their state of tranquillity. Besides these caterpillars, which in this manner roll up the leaves of plants, there are other species which only bend them once, and others, which by means of thin threads, connect many leaves together to make them a case. All this is a very surprising work, but much inferior to this method of rolling.

The different species of caterpillars have different inclinations, not only in their spinning and their choice of food, but even in their manners and behaviour one to another. Some never part company from the time of their being hatched to their last change, but live and feed together, and undergo together their change into the chrysalis state. Others separate one from another as soon as able to crawl about, and each seeks its fortune single; and there are others which regularly live to a certain time of their lives in community, and then separate, each to shift for itself, and never to meet again in that state. See ENTOMOLOGY, INSECTS, &c.

LARUS, the *gull*, in natural history, a genus of birds of the order Anseres. Generic character: bill strong, straight, sharp edged, bending down somewhat at the tip; lower mandible exhibiting an angular prominence; nostrils in the middle of the bill, body light; wings long; legs small, and naked above the knee; back toe small. They inhabit principally the northern climates, subsisting on carrion, and on fishes. They are reported, when greatly alarmed, almost universally to throw up from their stomach the food they have recently swallowed. Gmelin reckons fifteen species, and Latham nineteen. L. marinus, is twenty-nine inches in length, and of the weight of five pounds. It is found in various parts of England, and on most of the northern coasts of Europe. It breeds in the most elevated cliffs, laying its eggs on heaps of dung deposited by various birds. It feeds principally on fishes, but sometimes attacks birds, and is said to bear a particular enmity to the eider-duck. See Aves, Plate IX. fig. 2.

L. fuscus, or the herring gull, is somewhat less than the former, frequents the same situations, and subsists, like that, chiefly upon fish. In the herring season it is seen watching the nets of the fishermen, and is daring enough frequently to seize its prey from the boats and nets.

L. canus, or the common gull, is sixteen inches long, and about a pound in weight. It breeds on the rocks and cliffs on the British coasts, and on the banks of the Thames,

near its union with the sea, may be seen in immense numbers picking up the worms and small fishes deposited by the tide. It will also follow the course of the plough over the fields, and delights in the insects and worms which are thrown up by it. The cockchafer in its larva state, is a particular favourite with this bird. See Aves, Plate IX. fig. 1.

L. ridibundus, the black-cap, or pewit gull, breeds in the fens of Lincolnshire and Cambridgeshire, and, after the season of breeding is over, returns to the coasts. In some parts of Syria these birds are so familiar as to approach on being called, and to catch pieces of bread in the air as they are thrown up from the hands of the women. The old birds of this species are both rank and tough, but the young are eaten by many persons, and were formerly much admired for the table, taken so young as to be unable to fly. The particular islets in the fenny wastes of Lincolnshire, which used to be preferred by these birds for breeding, were every year in winter cleared of weeds, rushes, and other impediments, in preparation for their return in large flocks to breed in the spring, and when the young had attained the precise growth, several men were employed with long staves to hurry them into nets spread for their reception. This process constituted a favourite diversion, and the rich and fashionable assembled to be spectators of it from a considerable distance. The birds were sold at the rate of five shillings per dozen, and in the details of royal and noble feasts, will be found to have constituted an article of high and almost indispensable importance.

L. catarractus, or the brown gull, weighs about three pounds. It is more frequent in the cold than in the warmer latitudes, and is perhaps the most daring and fierce of all the species. In the Faro islands, lambs are stated to be often torn to pieces by it, and carried to its nest. On the island of Foula, however, it is said to be highly valued on account of its enmity to the eagle, which it attacks, and follows with the most animated hostility, in this instance becoming the means of security to flocks. It frequently makes prey of the smaller gulls and of other birds, and is often observed to watch the movements of birds on the water, and as they are bearing off their prey in triumph and imagined security, to pounce upon them with amazing rapidity, obliging them to drop their victims, which in the same instant are intercepted by this rapacious intruder. Even the albatross, when on the wing, though so much larger than this bird, is by no means a match for it in strength and courage, and finds its effectual resource only in alighting upon the water, which it does with all possible rapidity, when the skua immediately ceases to annoy it. During the season of incubation, the skua gull will attack every creature approaching its habitation, not excepting the human species, several of whom have been assailed by it in company, with an energy and fury truly formidable. Its feathers are in high estimation, and thought by many equal to those of the goose. It is in many places killed merely for these.

L. tridactylus, or the tarrock, breeds in Scotland, and is found so far north as Spitzbergen. It is an attendant on the progress of whales and other large fishes, which drive the smaller inhabitants of the ocean into creeks and shallows, where the tarrocks suddenly dart on them, ensuring always an easy and full repast. They are very clamorous, swim and fly well, are often seen on detached pieces of ice, are used by the inhabitants of Greenland for food, their eggs being highly valued for the same purpose, while their skins are converted into materials for caps and garments. For the black-toed gull, see Aves, Plate IX. fig. 3.

LARYNX, the thick upper part of the aspera arteria, or wind-pipe. See ANATOMY.

LASERPITIUM, in botany, *laserwort*, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ or Umbelliferæ. Essential character: petals bent in, emarginate, spreading; fruit oblong, with eight membranaceous angles. There are fifteen species, natives of the South of Europe.

LASIOSTOMA, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Apocineæ, Jussieu. Essential character: calyx very short, five petalled, with two acute scales; corolla funnel form, four-cleft; capsule orbiculate, one-celled, two-seeded. There is only one species, viz. L. rouhamon; this is a shrub, seven or eight feet in height, with a greyish irregular bark, and a whitish wood; branches and branchlets opposite, covered with a russet down, spreading over the neighbouring trees. The branchlets are knobbed, and at each joint have a pair of leaves, ending in a point; they are of a pale green colour, on short petioles; flowers in small axillary

corymbs, on a small peduncle, which has two scales at the base; corolla white; capsule yellow; this shrub is called by the Caribs rouhahamon; it is in flower and fruit during the months of October and November; it is found on the banks of the river Sinemari, in Guiana, forty leagues from its mouth.

LAST, in general, signifies the burden or load of a ship.

It signifies also a certain measure of fish, corn, wool, leather, &c. A last of cod-fish, white herrings, meal, and ashes for soap, is twelve barrels; of corn or rape-seed, ten quarters; of gun-powder, twenty-four barrels; of red-herrings, twenty cades; of hides, twelve dozen; of leather, twenty dickers; of pitch and tar, fourteen barrels; of wool, twelve sacks; of stock-fish, one thousand; of flax or feathers, 1700*lb*.

LATH, in building, a long, thin, and narrow slip of wood, nailed to the rafters of a roof or ceiling, in order to sustain the covering. These are distinguished into three kinds, according to the different kinds of wood of which they are made, *viz.* heart of oak, sap-laths, and deal laths; of which the two last are used for ceilings and partitions, and the first for tiling only. Laths are also distinguished according to their length, into five feet, four feet, and three feet laths, though the statute allows but of two lengths, those of five, and those of three feet, each of which ought to be an inch and a half in breadth, and half an inch in thickness, but they are commonly less.

Laths, *of cleaving*. The lath-cleavers having cut their timbers into lengths, they cleave each piece with wedges, into eight, twelve, or sixteen, according to the size of their timber; these pieces are called bolts; this is done by the felt-grain, which is that grain which is seen to run round in rings at the end of a piece of a tree. Thus they are cut out for the breadth of the laths, and this work is called felting. Afterwards they cleave the laths into their proper thicknesses with their chit, by the quarter-grain, which is that which runs in a straight line towards the pith. See Grain.

LATHE, in turning, is an engine used in turning wood, ivory, and other materials.

The lathe we are about to describe is made of iron in the best manner. See Plate Lathe. Fig. 1, is an elevation of the whole machine frontwise; fig. 2, an elevation sideways; fig. 3, an elevation of the lathe only on a larger scale; in fig. 4, are two elevations of an apparatus to be attached to the lathe for drilling holes; fig. 5, is an elevation of the rest; and fig. 6, a face elevation of one of the puppets.

The frame of the lathe is of wood, and consists of two ground cells, *a b*, two uprights, *d d*, morticed into them, and cross pieces, *e f*, at top connecting them together; upon the uppermost of these pieces the bench sustaining the lathe is fixed; *g* is another bench, supported by iron brackets, to receive a vice or other tools at the option of the workmen; between the two uprights, *d d*, the axis of the great foot wheel turns; it is pointed at the ends and turns in small conical holes in pieces of hard steel let into the uprights, *d d*, one of these holes is in the end of a screw, by turning which, the axis can be tightened up so as to turn very freely without any shake; the axis is made of wrought iron, and the points at the end are of hard steel welded together, it is bent in the middle to form a crank; and *h* is the connecting rod by which it is moved from a treadle, *i*; the treadle is a piece of board, *i*, seen endways, in fig. 2, screwed to an axle, *k*, at one end, on which it turns, and at the other end is broader to receive the workman's foot; in the middle a staple is fixed, and the connecting rod, *h*, hooked to it; A is the great wheel of cast iron, and of considerable weight in the rim, wedged fast on the axis, and turns round with it; it is by the momentum of this wheel that it continues to turn, while the crank and treadle are rising, and consequently when the workman exerts no power upon them. When the crank has passed the vertical position, and begins to descend, he presses his foot upon the treadle, to give the wheel a sufficient impetus, to continue its motion until it arrives at the same position again.

We now come to describe the upper part of the machine, or lathe, the wheel and treadle being only the first mover, it is shewn on a larger scale in fig. 3, and it is to this figure we shall refer in describing it; B B is a strong triangular iron bar, firmly supported by its ends, on two short pillars screwed at their lower ends to the bench; this bar is perfectly straight and the sides flat; D E are two iron standards, called puppets, fitted upon the triangular bar, D, and fixed at any place by screws, they are both alike, and one of them is shewn endways in fig. 6, it has an opening made in it at the bottom, the inside of which is filed extremely true to fit upon the upper angle of

the bar B B, through each of the branches, formed by the opening in the bottom mortices, are cut as is well seen in fig. 3; these receive the end of a short piece of iron, *m*, having a screw tapped into it; it is by screwing this screw tight up against the underside of the bar, that the puppet is fastened upon it; a small piece of iron plate is put between the end of the screw and the underside of the bar, to defend it from bruises by the latter; the upper end of the puppets are perforated with cylindrical holes, to receive truly turned pins, *n n*, and which are fixed at any place by screws, *o o*, these holes must be exactly in a line with each other, when the puppets are set at any place upon the bar, and it is to accomplish this, that too much care cannot be taken in forming the bar perfectly straight and true in the first instance, and of sufficient strength to preserve its figure. F is another puppet, fixed on the bar, in the same manner as D and E; it has a conical hole through its upper end, whose centre is exactly in the same line with the holes through the other two puppets D and E, this conical hole is the socket for the mandrill, G, to turn in, being conical at that part, and fitting the socket with the greatest accuracy; the other end is pointed, and turns in a hole made in the pin, *n*, of the puppet, D, and which besides the screw, *o*, has another at its end tapped into a cock, screwed to the puppet, to keep it up to its work; the mandrill has a pulley fixed on it, with three grooves of different sizes, to receive a band of catgut which goes over it, and round the great iron wheel, A A; it is by this that the mandrill is turned. I is the rest, composed of three principal pieces, shown separate in fig. 5, one of these pieces, *r*, is filed to an angle withinside, and furnished with a screw similar to the puppets, whereby it can be fastened to the bar; on each side of this, pieces of iron, *s s*, are laid on the bar, and are fastened together by two short bars, *t t*, to which they are both screwed, the main piece, *r*, being cut away to make room for them. L is the bottom part of the rest, supported on the two pieces, *s s*, it has a dove-tailed groove along the underside, a button, with a head like a screw, is fastened to the top of the main piece, *r*, and is received into the groove; when the screw of the piece, *r*, is turned, it draws the button down towards the bar, and as its head takes its bearing on the inside of the groove, it must hold the piece L fast down upon the pieces, *s s*; when the screw is loosened the whole rest can be moved along the bar B, the piece L can be slid backwards and forwards upon the pieces, *s s*, or it can be turned round upon the button of the piece, *r*, as a centre, at the convenience of the workmen; and all these motions are firmly clamped by the screw beneath the bar. The piece L has at one end a short iron tube fixed to it, in this an iron pin is fitted, to hold at its upper end the cross bar, V, on which the tool is laid, a screw is fixed in the tube, and a nut upon it presses a piece of iron, *w*, upon the ends of two short pins going through the tube, the other ends take against the large iron pin of the rest, V; when the nut is unscrewed the rest can be set higher or lower, or turned round obliquely, and fixed by turning the nut; the bar, *v*, of the rest, is fixed on by a screw, so that it can be easily changed for another when worn, or for different work there should be two or three of different sizes with the lathe. The mandrill, G, of the lathe should be of iron, and at the part where it turns in the collar, F, it should have a piece of good steel welded round it, and turned very true in a lathe, and also the point at the end should be of steel; a small hole is drilled down from the top of the puppet, F, into the collar to supply it occasionally with oil. The end of the mandrill, beyond the collar, is formed into a male screw, whereon to fix the work to be turned. The manner of holding the work varies in almost every instance, and is explained under the article TURNING; in general, it is held in pieces of wood called cheeks, screwed to the mandrill, they are turned hollow like a dish, and the work is driven into the cavity, as shown in fig. 1.

LATHRÆA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Pediculares, Jussieu. Essential character: calyx four-cleft; gland depressed at the base of the suture of the germ; capsule one-celled. There are four species, of which L. squamaria, great tooth-wort, has a headed root, branched and surrounded with white succulent scales; it is parasitical, and generally attached to the roots of elms, hasels, or some other trees, in a shady situation; or, it has usually a naked stem; flowers in a spike from one side of the stem in a double row; calyx hairy; segments equal; corolla pale purple, or flesh-coloured, except the lower lips, which is white. Native of most parts of Europe.

LATHYRUS, in botany, a genus of the

Diadelphia Decandria class and order. Natural order of Papilionaceæ or Leguminosæ. Essential character: calyx two, upper segments shorter; style flat, villose above, broader at the end. There are twenty-three species, among which is the L. odoratus, sweet lathyrus, or sweet pea, as it is commonly called, is an annual plant, about three feet in height, attaching itself to the nearest plant, by means of its long claspers or tendrils, the flower stalks come out at the joints, which are about six inches long, sustaining two large flowers, possessing a strong odour; these are succeeded by oblong hairy pods, having four or five roundish seeds in each. There are many varieties, according to Linnæus the common dark sort is a native of Sicily, and the painted lady of Ceylon.

LATITAT, in law, a writ, which in personal actions is the commencement of a suit in the King's Bench, where the party is to be arrested in any other county than Middlesex.

LATITUDE, the distance of a place from the equator, or an arc of the meridian intercepted between the zenith of the place and the equator. Hence latitude is either northern or southern, according as the place, whose latitude is spoken of, is on this or that side of the equator. Thus London is said to be in fifty-one degrees thirty-two minutes north latitude. Circles parallel to the equator, are called parallels of latitude, because they shew the latitudes of places by their intersection with the meridian. If through the poles of the world we conceive innumerable great circles drawn, these are called secondaries of the equator, and by their help, the position of every point, either on earth or in the heavens, with regard to the equinoctial; that is, the latitude of any point is determined. One of the secondaries, passing through any place on the earth's surface, is called the meridian of that place, and on it the latitude of that place is measured. The latitude of a place, and the elevation of the pole of that place above the horizon, are terms used indifferently for each other, because the latitude and elevation of the pole are always equal. The knowledge of the latitude of a place is of the utmost consequence in navigation; and the methods of determining it, both at sea and land, are generally the same. As the altitude of the pole is always equal to the latitude, the latitude is consequently best found by observing the pole's height; but as the pole is only a mathematical point, and no ways to be observed by our senses, its height cannot be determined in the same manner as that of the sun and stars, &c.; for which reason another manner has been contrived. A meridian line is first drawn, on which is placed a quadrant, so that its plane may be in the plane of the meridian; then some star near the pole is taken; for example, the pole star, (which never sets) and observation is made of both its greatest and least altitude. The latitude may also be found by having the sun or a star's declination and meridian altitude, taken with a quadrant or astrolabe. The method is this: observe the meridian and distance of the sun from the vertex or zenith, which is always the complement of his meridian altitude; correct for the dip of the horizon, refraction, and add to this the sun's declination, when the sun and the place are on the same side of the equator; and subtract the declination when they are of different sides; the sum, in the former case, and the difference in the latter, will be the latitude required. But when the declination of the sun is greater than the latitude of the place, which is known from the sun's being nearer to the elevated pole than the vertex of the place is, as it frequently happens in the torrid zone, then the difference between the sun's declination and his zenith distance, is the latitude of the place. If the sun or star have no declination, but move in the equinoctial that day, then the elevation of the equator will be equal to his meridian altitude, and consequently his meridian altitude is the complement of the latitude to ninety.

Latitude, in astronomy, the distance of a star or planet from the ecliptic, in degrees, minutes, and seconds, measured on a circle of latitude drawn through that star or planet, being either north or south, as the object is situated either on the north or south side of the ecliptic. The ecliptic being drawn on the common celestial globes, we may see what constellations it passes through: there are usually six circles of latitude, which, by their mutual intersections, show the poles of the ecliptic, as well as divide it into twelve equal parts, answerable to the number of months in a year.

LATTEN, denotes iron plates tinned over, of which tea-canisters are made. Plates of iron being prepared of a proper thinness, are smoothed by rusting them in an acid liquor, as common water made eager with rye; with this liquor they fill cer-

tain troughs, and then put in the plates, which they turn once or twice a day, that they may be equally rusted over; after this they are taken out, and well scowered with sand, and, to prevent their rusting again, are immediately plunged into pure water, in which they are to be left till the instant they are to be tinned or blanched, the manner of doing which is this: they flux the tin in a large iron crucible, which has the figure of an oblong pyramid with four faces, of which two opposite ones are less than the two others. The crucible is heated only from below, its upper part being luted with the furnace all round. The crucible is always deeper than the plates, which are to be tinned, are long; they always put them in downright, and the tin ought to swim over them; to this purpose artificers of different trades prepare plates of different shapes; though M. Reaumur thinks them all exceptionable. But the Germans use no sort of preparation of the iron, to make it receive the tin, more than the keeping it always steeped in water, till the time; only when the tin is melted in the crucible, they cover it with a layer of a sort of suet, which is usually two inches thick, and the plate must pass through this before it can come to the melted tin. The first use of this covering is to keep the tin from burning; for if any part should take fire, the suet would soon moisten it, and reduce it to its primitive state again. The blanchers say, this suet is a compounded matter; it is indeed of a black colour, but M. Reaumur supposed that to be only an artifice, to make it a secret, and that it is only coloured with soot or the smoke of a chimney; but he found it true so far, that the common unprepared suet was not sufficient; for after several attempts, there was always something wanting to render the success of the operation certain. The whole secret of blanching, therefore, was found to lie in the preparation of this suet; and this, at length, he discovered to consist only in the first frying and burning it. This simple operation not only gives it the colour, but puts it into a condition to give the iron a disposition to be tinned, which it does surprisingly. The melted tin must also have a certain degree of heat, for if it is not hot enough, it will not stick to the iron; and if it is too hot, it will cover it with too thin a coat, and the plates will have several colours, as red, blue, and purple, and upon the whole will have a cast of yellow. To prevent this, by knowing when the fire has a proper degree of heat, they might try with small pieces of iron; but in general, use teaches them to know the degree, and they put in the iron when the tin is at a different standard of heat, according as they would give it a thicker or thinner coat. Sometimes also they give the plates a double layer, as they would have them very thickly covered. This they do by dipping them into the tin, when very hot, the first time; and when less hot, the second. The tin which is to give the second coat, must be fresh covered with suet, and that with the common suet, not the prepared.

LATUS *rectum*, in conic sections, the same with parameter. See PARAMETER.

LATUS *transversum*, in the hyperbola, that part of the transverse diameter, intercepted between the vertices of the two opposite sections. See HYPERBOLA.

LAVA, the production of Ætna, Vesuvius, Hecla, and other volcanoes, is of a greyish colour passing to green: it is spotted externally, and occurs porous, carious, or vesicular. Its lustre is vitreous, more or less glistering. It is moderately hard, brittle, easily frangible, and light. It generally attracts strongly the magnetic needle. It is easily fusible into a black, compact glass. It frequently encloses other fossils, especially crystals of felspar, augite, hornblende, and leucite. See VOLCANIC *formations*.

LAVANDULA, in botany, *lavender*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: calyx ovate, obscurely toothed, supported by a bracte; corolla re-supine; stamina within the tube. There are seven species, of which L. spica, common lavender, has a shrubby stem much branched, frequently five or six feet high, with numerous hoary leaves, the upper ones sessile, the lower petioled; the flowers are produced in terminating spikes from the young shoots, on long peduncles; the spikes are composed of interrupted whorls, in which the flowers are from six to ten, the lower whorls more remote; each flower upright, on a short pedicel; the usual colour of the corolla is blue, sometimes varying with white flowers; the whole plant is covered with a down, composed of forked hairs. It is a native of the south of Europe, and has long been celebrated for its virtues in nervous disorders; the officinal preparations of lavender, are the essential oil, a simple spirit, and a compound tincture.

LAVATERA, in botany, so named from

Lavater, a physician at Zurich; a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx double, outer trifid; arils very many, one-seeded. There are nine species, of which L. arborea, lavatera or mallow-tree, rises in gardens, with a strong, thick stalk, frequently to the height of eight or ten feet; in its wild state, not more than four or five; leaves alternate, cordate, roundish, seven-angled, the angles blunt, but soft as velvet, shorter than the petioles; flowers mostly in pairs, sometimes three together, on upright peduncles, an inch and half in length; corolla purplish red, spreading, bell-shaped, like that of the common mallow, an inch or more in diameter; petals broader at top than at the base, so that the calyx appears between the claws. The ring or whorl of fruits is seven or eight-capsuled; common receptacle awl-shaped, with a conoid globule at top, and small crescent-shaped lamellæ at the base, and the interstices of the capsules. Native of Italy, the Levant, and Britain.

LAVENIA, in botany, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ Discoideæ. Essential character: calyx nearly regular, style bifid; down three-awned, glandular at the tip. There are two species, *viz.* L. decumbens, and L. erecta, the former is a native of Jamaica, and the latter of the East Indies and the Society Isles.

LAUGERIA, in botany, so called from Robert Laugier, professor of chemistry and botany at Vienna; a genus of the Pentandria Monogynia class and order. Natural order of Rubiaceæ, Jussieu. Essential character: corolla five-cleft; drupe with a five-celled nut. There are three species, natives of America, West Indies, and Santa Cruz.

LAURUS, in botany, *bay-tree*, a genus of the Enneandria Monogynia class and order. Natural order of Holoraceæ. Lauri, Jussieu. Essential character: calyx none; corolla calycine, six-parted; nectary of three two-bristled glands, surrounding the germ; filaments inner, glanduliferous; drupe one-seeded. There are thirty-two species. This genus consists of trees or shrubs; leaves mostly entire, in a few nearly opposite, commonly perennial, as in most trees of the torrid zone. L. nobilis, common sweet-bay, has been celebrated in all ages; with us it appears as a shrub; but in the southern parts of Europe, it grows from twenty to thirty feet in height; it has large evergreen leaves, of a firm texture, with an agreeable smell, and an aromatic, bitterish taste; flowers dioecious, or male and female on different trees, in racemes shorter than the leaves, of an herbaceous colour; corollas four-petalled in the male flowers; stamens from eight to twelve; berry superior, of a dark purple colour, almost black. It is a native of the southern parts of Europe and Asia. L. persea, alligator, or avocado pear, of the West Indies, is about thirty feet in height; the bark is smooth, and of an ash colour; the branches have large, smooth leaves, like those of laurel; the flowers are mostly produced towards the extremities of the branches; the fruit is the size of one of our biggest pears, inclosing a large seed with two lobes. This fruit is held in great esteem in the West Indies; the pulp is of a pretty firm consistence, and has a delicate, rich flavour; it gains upon the palate of most persons, and soon becomes agreeable even to those who cannot like it at first; it is very rich and mild, so that most people make use of some spice or pungent substance to give it a poignancy.

LAW, (*Sax. lag. Lat. lex*, from *lego*, or *legendo*, choosing, or rather *a ligando*, from binding), the rule and bond of men's actions: or it is a rule for the well governing of civil society, to give to every man that which doth belong to him.

Law, in its most general and comprehensive sense, is defined by Blackstone, in the Commentaries, 'a rule of action,' and is applied indiscriminately to all kinds of action, whether animate or inanimate, rational or irrational. And it is that rule of action which is prescribed by some superior, and which the inferior is bound to obey.

Laws in their more confined sense, and in which it is the business of works of this nature to consider them, denote the rules, not of action in general, but of human action or conduct. And this perhaps (it has been acutely observed) is the only sense in which the word law can be strictly used; for in all cases where it is not applied to human conduct, it may be considered as a metaphor, and in every instance a more appropriate term (as quality or property) may be found. When law is applied to any other object than man, it ceases to contain two of its essential ingredients, disobedience and punishment.

Municipal law, is by the same great com-

mentator defined to be "a rule of civil conduct prescribed by the supreme power in a state; commanding what is right, and prohibiting what is wrong." The latter clause of this sentence seems to Mr. Christian to be either superfluous or defective. If we attend to the learned judge's exposition, perhaps we may be inclined to use the words "establishing and ascertaining what is right or wrong;" and all cavil or difficulty will vanish.

Every law may be said to consist of several parts; declaratory, whereby the rights to be observed, and the wrong, to be eschewed, are clearly defined and laid down: directory, whereby the subject of a state is instructed and enjoined to observe those rights, and to abstain from the commission of those wrongs: remedial, whereby a method is pointed out to recover a man's private rights or redress his private wrongs; vindicatory, which imposes the sanction whereby it is signified what evil or penalty shall be incurred by such as commit any public wrongs, and transgress or neglect any duty.

Laws are arbitrary or positive, and natural; the last of which are essentially just and good, and bind every where and in all places where they are observed: arbitrary laws are either concerning such matter as is in itself morally indifferent, in which case both the law and the matter, and subject of it, are likewise indifferent, or concerning the natural law itself, and the regulating thereof; and all arbitrary laws are founded in convenience, and depend upon the authority of the legislative power which appoints and makes them, and are for maintaining public order; those which are natural laws are from God; but those which are arbitrary, are properly human and positive institutions.

The laws of any country began, when there first began to be a state in the land; and we may consider the world as one universal society, and then that law by which nations where governed, is called *jus gentium;* if we consider the world as made up of particular nations, the law which regulates the public order and right of them, is termed *Jus publicum;* and that law which determines the private rights of men, is called *jus civile*.

No law can oblige a people without their consent, this consent is either *verbis* or *factis*, *i. e.* it is expressed by writing, or implied by deeds and actions; and where a law is grounded on an implied assent, *rebus et factis*, it is either common law or custom; if it is universal, it is common law; and if particular to this or that place, then it is custom.

The law in this land hath been variable; the Roman laws, were in use anciently in Britain, when the Romans had several colonies here, each of which was governed by the Roman laws: afterwards we had the laws called Merchenlage, West Saxonlage, and Danelage; all reduced into a body, and made one by King Edward the Confessor.

At present the laws of England are divided into three parts: 1. The common law, which is the most ancient and general law of the realm, and common to the whole kingdom, being appropriate thereto, and having no dependence upon any foreign law, whatsoever.

2. Statutes or acts of parliament, made and passed by the King, Lords, and Commons in Parliament; being a reserve for the government to provide against new mischiefs arising through the corruption of the times. And by this the common law is amended where defective, for the suppression of public evils; though where the common law and statute law concur or interfere, the common law shall be preferred.

3. Particular customs. These must be particular, for a general custom is part of the common law of the land.

Blackstone divides the municipal law of England into two kinds, *lex non scripta*, the unwritten or common law; and the *lex scripta*, the written, that is, the statute law.

The *lex non scripta*, or unwritten law, includes not only general customs, or the common law properly so called; but also the particular customs of certain parts of the kingdom; and likewise those particular laws, that are by custom observed only in certain courts and jurisdictions.

There is another division of our laws; more large and particular; as into the prerogative or crown law, the law and custom of parliament, the common law, the statute law, reasonable customs, the law of arms, war, and chivalry, ecclesiastical or canon law, civil law, in certain courts and cases, forest law, the law of marque and reprisal, the law of merchants, the law and privilege of the stannaries, &c. But this large division may be reduced to the common division; and all is founded on the law of nature and reason, and the revealed law of God, as all other laws ought to be.

The law of nature is that which God, at

man's creation infused into him, for his preservation and direction; and this is *lex æterna*, and may not be changed; and no laws shall be made or kept, that are expressly against the law of God, written in his scripture; as to forbid what he commandeth.

All laws derive their force *a lege naturæ;* and those which do not, are accounted as no laws. No law will make a construction to do wrong; and there are some things which the law favours, and some it dislikes; it favoureth those things that come from the order of nature. Also our law hath much more respect to life, liberty, freehold, inheritance, matters of record, and of substance; than to chattels, things in the personalty, matters not of record, on circumstances.

LAW *of nations*, is a system of rules deducible by natural reason, from the immutable principles of natural justice, and established by universal consent amougt the civilized inhabitants of the world, in order to decide all disputes, and to insure the observance of justice and good faith, in that intercourse which must frequently occur between them and the individuals belonging to each; or they may depend upon mutual compacts, treaties, leagues, and agreements between the separate, free, and independent communities. In the construction of these principles, there is no judge to resort to, but the general law of nature and of reason, being the only law with which the contracting parties are all equally conversant, and to which they are all equally amenable. Laws have properly their effect only in the country where and for which they have been enacted. However, 1. Those which relate to the state, and to the personal condition of the subjects, are acknowledged in foreign countries. 2. A foreigner, who is plaintiff against a subject, must abide by the decisions of the law of the country in which he pleads. 3. When the validity of an act done in a foreign country is in question, it ought to be decided by the laws of that foreign country. 4. Sometimes the parties agree to the question being determined by particular laws of a foreign country. 5. A foreign law may have been received as a subsidiary law. 6. Foreigners sometimes obtain the privilege of having their disputes with each other settled by the laws of their own country.

LAWSONIA, in botany, so named from Isaac Lawson, M. D. a genus of the Octandria Monogynia class and order. Natural order of Salicariæ, Jussieu. Essential character: calyx four-cleft; petals four; stamens in four pairs; capsule four-celled, many-seeded. There are four species; natives of warm countries.

LAXMANNIA, in botany, so called from Ericus Laxman, a Swede, a genus of the Hexandria Monogynia class and order. Essential character: calyx one-leafed, four-toothed, inferior; corolla four-petalled; berry four-celled; seeds solitary.

LAYERS, in gardening, are tender shoots, or twigs of trees, laid or buried in the ground; till having struck root, they are separated from the parent tree, and become distinct plants.

LAZULITE, in mineralogy, is of a deep smalt blue: it occurs disseminated in fine grains, or masses of the size of a hazel nut. The latter often present the appearance of short tetrahedral prisms. Its fracture is uneven, with a glimmering lustre. It is brittle, and easily frangible: at a red heat it loses its colour, and becomes grey. Without addition it is infusible before the blow-pipe, but with borax it runs into a clear yellow glass. It has been analyzed by Klaproth, and is found to contain silex, alumina, and oxide of iron.

LAZURSTEIN, in mineralogy, called also *azure-stone*, a species of the flint genus, is of a perfect azure blue colour, in some varieties it passes into sky blue: it is found massive, disseminated, and in rolled pieces: hard, brittle, and not heavy: specific gravity is from 2.7 to 2.95. It melts into a white enamel before the blow-pipe. When previously calcined and powdered, it forms a jelly with acids: it is composed of

Silica	46.0
Alumina	14.5
Carbonate of lime	28.0
Sulphate of lime	6.5
Oxide of iron	3.0
Water	2.0
	100.0

It has been found in Persia, Bucharia, China, Great Tartary, and Siberia: it is also obtained in considerable quantities in the island of Hainan, in the Chinese sea, from whence it is sent to Canton, where it is employed in painting. It has likewise been met with in South America; and in Europe among the ruins at Rome. It is used in various articles of ornamental dress, and in Mosaic and Florentine work, and is highly

valued on account of the fine blue colour which it yields.

LEAD, is a white metal, of a considerably blue tinge, very soft and flexible, not very tenacious, and consequently incapable of being drawn into fine wire, though it is easily extended into thin plates under the hammer. Its weight is very considerable, being rather greater than that of silver. Long before ignition, namely, at about the 540th degree of Fahrenheit's thermometer, it melts; and then begins to be oxyded if respirable air be present. In a strong heat it boils, and emits fumes; during which time, if exposed to the air, its oxydation proceeds with considerable rapidity. If melted lead be poured into a box previously rubbed with chalk, to prevent its action on the wood, and be continually agitated, it will concrete into separate grains, of considerable use in various mechanical operations, particularly that of weighing. Lead is brittle at the time of congelation. In this state it may be broken to pieces with a hammer, and the crystallization of its internal parts will exhibit an arrangement in parallel lines.

This metal, during the progress of heat, first becomes converted into a dusky powder, which by a continuation of the heat becomes white, yellow, and afterwards of a bright red, inclining to orange colour, called minium, or red lead. The process requires considerable management with regard to the heat and access of air, in the making of red lead. Many days are required for this purpose. If the heat be too great or rapid, the lead becomes converted into a flaky substance, called litharge; and a still greater heat converts it into a clear, transparent, yellow glass, which powerfully dissolves and corrodes metallic oxides or earths; and on this account it usually finds its way through the crucibles in a short time. It acts more difficultly on argillaceous than on siliceous earths; whence it is found that vessels made of clay mixed with broken pottery are preferable to those that are composed of clay and sand. The oxide of lead is a principal ingredient in most of the modern fine white glasses. It is more particularly calculated to form the dense glass used to correct the aberration arising from colour in those telescopes which are known by the name of achromatic, because it communicates the property of separating the coloured rays from each other in greater angles than obtain in alkaline glasses at equal angles of mean refraction. The imperfection which most considerably affects this kind of glass is, that its density is seldom uniform throughout. The irregularities show themselves in the forms of veins, which greatly disturb the regular refraction.

Lead is not much altered by exposure to air or water, though the brightness of its surface when cut or scraped very soon goes off. It is probable that a thin stratum of oxide is formed on the surface, which defends the rest of the metal from corrosion.

All the oxides of lead are very easily reduced. Minium, when exposed to a strong heat, gives out part of the oxygen it absorbed during its oxidation; but, like the other oxides of this metal, it requires the addition of some combustible substance for its complete revival: a familiar instance of this revival is seen by exposing the common wafers to the flame of a candle. The wafers are coloured with minium, which is revived by the heat and inflammable substance of the wafer, so that it falls down in metallic globules.

Lead is found native, though seldom; and also in the form of an oxide, called native ceruse, or lead ochre, or lead spar of various colours, red, brown, yellow, green, blueish, and black, These ores, when freed as much as possible from earthy matter, may be dissolved in diluted nitrous acid. Oxide of iron is usually thrown down from the solution by boiling. If the lead be then precipitated by the carbonate of soda, and weighed, 132 grains of the dry precipitate will correspond with 100 grains of lead in the metallic state. If the precipitate be suspected to contain copper, it may be separated by digesting in ammonia. If it be supposed to contain silver and copper, the precipitate may again be dissolved in nitric acid, and separated by the addition of muriatic acid; which combining with the metal, produces the muriates of silver, and of lead; the latter of which being soluble in thirty times its weight of boiling water, may be washed off, while the silver remains undissolved; or the silver, if alone in the precipitate, may be taken up by ammonia, which will leave the oxide of lead of the same value with regard to weight as the foregoing.

Lead is also found mineralized by the sulphuric and the phosphoric acids; this last is of a greenish colour, arising from a mixture of iron. The sulphate of lead is soluble in about eighteen times its weight of water. One hundred and forty-three grains of the dried salt represent 100 grains of lead. The phosphate of lead ore may be

dissolved in nitric acid by means of heat, except a few particles of iron, which remain at the bottom. By the addition of sulphuric acid, the lead is thrown down in the form of white flakes of sulphate; which, when washed and dried, discover the quantity of lead they contain, by the same allowance of 143 grains of the salt to 100 grains of metallic lead. The remaining solution being evaporated to dryness, affords phosphoric acid. Lead is abundantly found in combination with sulphur, in the form of heavy, shining, black, or bluish, lead-coloured cubical masses, whose corners are usually truncated; its texture is laminated, and its hardness variable. This is called galena, or potter's lead ore. Most lead ores contain more or less of silver. When antimony enters into its composition, the texture is radiated or filamentous. There are also lead pyrites, which contain a considerable proportion of iron and sulphur; and red lead spar, which consists of lead mineralized by sulphur and arsenic: this is very scarce.

If sulphuretted lead be boiled in nitric or muriatic acid of a moderate strength, the sulphur may be obtained pure, and collected on a filter. When iron or stony particles are contained among the undissolved part, the sulphur may be separated by digestion in a solution of pure fixed alkali, which converts it into sulphuret, and leaves the other insoluble matters behind. If the first solution be made with nitric acid, it may contain silver and lead, which after precipitation by carbonate of soda, may be separated by ammonia, as mentioned in the humid analysis of the calciform ores; when the muriatic acid is used for the solution of the ore, a large quantity of muriate of lead separates, for want of a sufficient quantity of water to dissolve it. This requisite quantity of water must be added to dissolve the salt, before the precipitate is made by the fixed alkali.

All the ores of lead, except the phosphoric, are reducible to the metallic state by dissipating their volatile contents by the blow-pipe on a piece of charcoal. In the large way, they are reduced by fusion with charcoal.

The ores of this metal are abundantly found in the mine counties of England, and in various other parts of the globe. Its uses are numerous, and scarcely need be mentioned. Its oxides are of great use as a pigment, and in the manufacture of glass. Lead is cast into thin sheets for covering buildings, making water-pipes, and various other uses; and this is rolled between two cylinders of iron, to give it the requisite uniformity and thinness. Lead is thought, and with some reason, to be not perfectly innocent, even for water pipes, and much less so for any other kind of vessels. The workmen in any of the preparations of lead are generally subject to a peculiar colic, and paralytic disorders, which most probably arise from the internal use of the metal; for it is a fact, that these workmen are not sufficiently cautious in washing their hands, or removing such particles of lead, or its preparations, as may casually intermix with their food.

Most of the acids attack lead. The sulphuric acid scarcely acts upon it, unless it be concentrated and boiling. Sulphurous acid escapes during the process, the acid being decomposed. When the distillation is carried on to dryness, a saline white mass remains, a small portion of which is soluble in water, and is the sulphate of lead: it affords crystals. The residue of the white mass is an oxide of lead.

Nitric acid acts strongly on lead, and converts it into a white oxide if the acid be concentrated; but if it be more diluted, the oxide is dissolved, and forms nitrate of lead which is crystallizable, and does not afford a precipitate by cooling. It detonates on ignited coals. Lime and alkalies decompose the nitrous solution of lead. The sulphuric acid added to this solution combines with the metallic oxide, and falls down. The muriatic acid in the same manner carries down the lead, and forms a combination which is more soluble in water than the muriate of silver.

Muriatic acid acts directly, but sparingly, on lead by heat, which it oxides, and dissolves in part. The muriate of lead is crystallizable.

The acetic acid dissolves lead and its oxides; though the access of air or oxygen seems necessary for the solution of the metal itself in this acid. White lead, or ceruse, is made by rolling leaden plates spirally up, so as to leave the space of about an inch between each coil, and placing them vertically in earthen pots, at the bottom of which is some good vinegar. The pots are to be covered, and exposed for a length of time to a gentle heat in a sand bath, or by bedding them in dung. The vapour of the vinegar, assisted by the tendency of the lead, to combine with the oxygen of the air which is present, corrodes the lead, and converts the external

portion into a white oxide, which comes off in flakes when the lead is uncoiled. The plates are thus treated repeatedly, until they are corroded through. Ceruse is the only white substance used in oil paintings. It may be dissolved without difficulty in the acetous acid, and affords a crystallizable salt, called sugar of lead, from its sweet taste. This, like all the preparations of lead, is poisonous.

The sulphurets precipitate lead from its solutions, the sulphur falling down in combination with the lead. Pure alkaline solutions dissolve a small portion of lead, and corrode a considerable quantity: the solution is said to give a black colour to the hair.

Oils dissolve the oxides of lead, and become thick and consistent; in which state they are used as the basis of plasters, cements for water-works, paints, &c.

In the dry way, lead alone is oxided and vitrified. When fused with fixed alkaline salts, it is converted into a dark coloured scoria, partly soluble in water. The neutral salts in general are not acted upon by lead. Nitre oxides this metal when heated with it, though scarcely any commotion or apparent flame is produced by its action. Sulphur readily dissolves it in the dry way, and produces a brittle compound, of a deep grey colour, and brilliant appearance, which is much less fusible than lead itself; a property which is common to all the combinations of sulphur with the more fusible metals.

The phosphoric acid, exposed to heat together with charcoal and lead, becomes converted into phosphorus, which combines with the metal. This combination does not greatly differ in appearance from ordinary lead: it is malleable, and easily cut with a knife; but it loses its brilliancy more speedily than pure lead; and, when fused upon charcoal with the blow-pipe, the phosphorus burns, and leaves the lead behind.

Lead decomposes sal ammoniac, or muriate of ammonia, by the assistance of heat: its oxides unite with the muriatic acid of that salt in the cold, and disengage its volatile alkali. When the volatile alkali is obtained by distilling sal ammoniac with the oxides of lead, the residue consists of the muriate of lead.

Litharge fused with common salt decomposes it; the lead unites with muriatic acid, and forms a yellow compound, at present used in this country as a pigment. The alkali either floats at top, or is volatilized by the heat if strongly urged. The same decomposition takes place in the humid way, if common salt be macerated with litharge, and the solution will contain the pure alkali.

Lead unites with most of the metals. Gold and silver are dissolved by it in a slight red heat. Both these metals are said to be rendered brittle by a small admixture of lead, though lead itself is rendered more ductile by a small quantity of them. Platina forms a brittle compound with lead; mercury amalgamates with it; but the lead is separated from the mercury by agitation, in the form of an impalpable black powder, if oxygen be present, which is at the same time absorbed. Copper and lead do not unite but with a strong heat. If lead be heated so as to boil and smoke, it soon dissolves pieces of copper thrown into it: the mixture when cold is brittle. The union of these two metals is remarkably slight; for, upon exposing the mass to a heat no greater than that in which lead melts, the lead almost entirely runs off by itself. This process, which is peculiar to lead with copper, is called eliquation. The coarser sorts of lead, which owe their brittleness and granulated texture to an admixture of copper; throw it up to the surface on being melted to a small heat. Iron does not unite with lead, as long as both substances retain their metallic form. Tin unites very easily with this metal, and forms a compound which is much more fusible than lead by itself, and is for that reason used as a solder for lead. Two parts of lead and one of tin, form an alloy more fusible than either metal alone; this is the solder of the plumbers. Bismuth combines readily with lead, and affords a metal of a fine close grain, but very brittle. A mixture of eight parts bismuth, five lead, and three tin, will melt in a heat which is not sufficient to cause water to boil. Antimony forms a brittle alloy with lead. Nickel, cobalt, manganese, and zinc, do not unite with lead by fusion.

It will appear from the foregoing observations, that the uses of lead are very extensive. It is easily reduced to thin sheets, adapted to the covering of buildings; to be formed into pipes of all sizes, and fitted for divers purposes. Its oxides are used as paints; in the manufacture of glass; and in the glazing of earthen-ware, &c.

Lead, *black*. See the article Iron.

Lead, *sugar of*. A salt, denominated from its composition, by modern chemists,

acetite of lead, is much used in calico-printing, and other manufactures.

LEAGUE, a measure of length, containing more or less geometrical paces, according to the different usages and customs of countries. A league at sea, where it is chiefly used by us, being a land measure mostly peculiar to the French and Germans, contains 3,000 geometrical paces, or three English miles. The French league sometimes contains the same measure, and in some parts of France it consists of 3,500 paces: the mean or common league consists of 2,400 paces, and the little league of 2,000. The Spanish leagues are larger than the French, seventeen Spanish leagues making a degree, or twenty French leagues, or sixty-nine and an half English statute miles. The Dutch and German leagues contain each four geographical miles. The Persian leagues are pretty nearly of the same extent with the Spanish; that is, they are equal to four Italian miles; which is nearly what Herodotus calls the length of the Persian parasang, that contained thirty stadia, eight whereof, according to Strabo, make a mile.

LEAK, among seamen, is a hole in the ship through which the water comes in. To spring a leak, is said of a ship that begins to leak. To stop a leak, is to fill it with a plug wrapt in oakum and well tarred; or putting in a tarpaulin clout, to keep the water out; or nailing a piece of sheet-lead upon the place.

LEAKAGE, the state of a vessel that leaks, or lets water, or other liquid, ouze in or out. See the preceding article. Leakage, in commerce, is an allowance of 12 per cent in the customs, allowed to importers of wines for the waste and damage it is supposed to have received in the passage: an allowance of two barrels in twenty-two is also made to the brewers of ale and beer by the excise-office.

LEAP *year*, the same with bissextile. See Bissextile. Every centesimal, or hundredth year, is a leap year, according to the Julian account, but according to the Gregorian, it is always a common year, except when the number of centuries can be divided by four without a remainder, for then it is a leap year; but the intermediate centesimal years are common ones: hence, to know if it be leap year, the rule is, If the year consists of complete centuries, and can be divided by 4, it is leap year; as it is also when the intermediate years can be divided by 4: thus the present year 1808 is a leap year; for 8 may be divided by four without a remainder. If the intermediate years cannot be divided by 4, the remainder shows the number of years over leap year.

LEASE, a conveyance of lands, or tenements, for a term of years, or during the continuance of a life or lives, in consideration of a stipulated rent or other recompense.

The purchaser of a lease may be considered as the purchaser of an annuity equal to the rack-rent, for whether he possesses the estate himself, or lets it out to another, he has an interest in the same equal to the annual rent thereof; therefore, from the principles on which the present value of annuities is ascertained, the value of leases is likewise found. When a certain sum is paid down for the grant of a lease, it may be considered as so much money paid in advance for the annual rents as they may become due; therefore, in order to ascertain what the sum ought to be, it would be necessary to find, separately, the present value of each annual rent, or the sum which put out to interest at the given rate would amount to the rent at the time it became due; and these separate values of each year's rent added together would give the sum to be paid down as the present value of the lease. The rate of interest at which money is supposed to be improveable, affects the value of leases very materially, as the higher the current rate of interest is, the less will any one be disposed to give for payments to be received at future periods: thus if 6 per cent. interest can be readily obtained for money, no one will give the same sum for a certain yearly rent as if he could only make 4 per cent. interest of his money. Having then determined on the rate of interest at which money is to be improved, it is only necessary to find, at that rate of interest, the present value of an annuity equal to the net yearly rent of the estate, in order to ascertain the value of the lease. This is given, at 5 per cent. interest, in Table II. article Annuities: but as most persons in the purchase of leases, particularly of houses, expect to make rather more than the current interest for money, the following table is better adapted for answering all practical questions relating to this subject.

TABLE

Shewing the Number of Years Purchase to be given for a Lease, of any Number of Years not exceeding 100 years, at 6, 7, and 8 per Cent. Compound Interest.

Years.	6 per Cent.	7 per Cent.	8 per Cent.	Years.	6 per Cent.	7 per Cent.	8 per Cent.
1	.9433	.9345	.9259	51	15.8130	13.8324	12.2532
2	1.8333	1.8080	1.7832	52	15.8613	13.8621	12.2715
3	2.6730	2.6243	2.5770	53	15.9069	13.8898	12.2864
4	3.4651	3.3872	3.3121	54	15.9499	13.9157	12.3041
5	4.2123	4.1001	3.2927	55	15.9905	13.9399	12.3186
6	4.9173	4.7665	4.6228	56	16.0288	13.9625	12.3320
7	5.5823	5.3892	5.2063	57	16.0649	13.9837	12.3444
8	6.2097	5.9712	5.7466	58	16.0989	14.0034	12.3560
9	6.8016	6.5152	6.2468	59	16.1311	14.0219	12.3669
10	7.3600	7.0235	6.7100	60	16.1614	14.0391	12.3765
11	7.8868	7.4986	7.1389	61	16.1900	14.0553	12.3856
12	8.3838	7.9426	7.5360	62	16.2170	14.0703	12.3941
13	8.8526	8.3576	7.9037	63	16.2424	14.0844	12.4020
14	9.2949	8.7454	8.2442	64	16.2664	14.0976	12.4092
15	9.7122	9.1079	8.5594	65	16.2891	14.1099	12.4159
16	10.1058	9.4466	8.8513	66	16.3104	14.1214	12.4222
17	10.4772	9.7632	9.1216	67	16.3306	14.1321	12.4279
18	10.8276	10.0590	9.3718	68	16.3496	14.1422	12.4333
19	11.1581	10.3355	9.6035	69	16.3676	14.1516	12.4382
20	11.4699	10.5940	9.8181	70	16.3845	14.1603	12.4428
21	11.7640	10.8355	10.0168	71	16.4005	14.1685	12.4470
22	12.0415	11.0612	10.2007	72	16.4155	14.1762	12.4509
23	12.3033	11.2721	10.3710	73	16.4297	14.1834	12.4546
24	12.5503	11.4693	10.5287	74	16.1431	14.1901	12.1579
25	12.7833	11.6535	10.6747	75	16.4558	14.1963	12.3610
26	13.0031	11.8257	10.8099	76	16.4677	14.2022	12.4639
27	13.2105	11.9867	10.9351	77	16.4790	14.2076	12.4666
28	13.4061	12.1371	11.0510	78	15.4896	14.2127	12.4691
29	13.5907	12.2776	11.1584	79	16.4996	14.2175	12.4713
30	13.7648	12.4090	11.2577	80	16.5091	14.2220	12.4735
31	13.9290	12.5318	11.3497	81	16.5180	14.2261	12.4754
32	14.0840	12.6465	11.4349	82	16.5264	14.2300	12.4772
33	14.2302	12.7537	11.5138	83	16.5343	14.2337	12.4789
34	14.3681	12.8540	11.5869	84	16.5418	14.2371	12.4805
35	14.4982	12.9476	11.6545	85	16.5489	14.2402	12.4819
36	14.6209	13.0352	11.7171	86	16.5556	14.2432	12.4833
37	14.7567	13.1170	11.7751	87	16.5618	14.2460	12.4845
38	14.8460	13.1934	11.8288	88	16.5678	14.2486	12.4856
39	14.9490	13.2649	11.8785	89	16.5734	14.2510	12.4867
40	15.0462	13.3317	11.9246	90	16.5787	14.2533	12.4877
41	15.1380	13.3941	11.9672	91	16.5836	14.2554	12.4886
42	15.2245	13.4524	12.0066	92	16.5883	14.2574	12.4894
43	15.3061	13.5069	12.0432	93	16.5928	14.2592	12.4902
44	15.3831	13.5579	12.0770	94	16.5969	14.2610	12.4909
45	15.4558	13.6055	12.1084	95	16.6009	14.2626	12.4916
46	15.5248	13.6500	12.1374	96	16.6046	14.2641	12.4922
47	15.5890	13.6916	12.1642	97	16.6081	14.2655	12.4928
48	15.6500	13.7304	12.1891	98	16.6114	14.2668	12.4933
49	15.7075	13.7667	12.2121	99	16.6145	14.2680	12.4938
50	15.7618	13.8007	12.2334	100	16.6175	14.2692	12.4943

In order to find the valne of a lease for any term, the true rack rent of the estate, or the annual value that it may be justly estimated to be worth, must be first ascertained; otherwise it will be impossible to determine, with any degree of accuracy, the real sum which ought to be given for the purchase of the same; for as the values in the Table denote merely the number of years purchase, it is evident that the sum

deduced therefrom will vary according as the annual rent of the estate varies. On this point, difficulties will sometimes arise; for the value of an estate, depending very often on some real or supposed advantages, or on some local or personal recommendations, will, in many instances, occasion a difference of opinion; and, in most cases, be a matter of some uncertainty. Some annual rent must, however, be fixed upon as the full sum for which the estate would let, and this rent being multiplied by the sum in the Table, corresponding with the term of years, gives the present value of the lease. Thus, if a house lets for 50*l.* per ann. to find the value of a lease thereof for 21 years, reckoning interest at 6 per cent. multiply 50 by 11,764 (the sum in the table corresponding with 21 years) which gives the answer 588*l.* 4*s.* It frequently happens that the rent of an estate is charged with some annual expense, such as a reserved or quit-rent, the payment of an annuity, taxes, and the like; in such cases, the various charges must be first deducted from the rent received, and the remainder, or nett-rent, only, be multiplied by the number of years purchase in the table.

Example. A person holds a lease, for 35 years, of premises which let for 120*l.* per annum, out of which he pays 17*l.* 10*s.* for ground-rent, and 4*l.* 10*s.* for land-tax; what should he require for the lease, allowing the purchaser to make 7 per cent. interest of his money? The payments to which the rent is subject being deducted, leave a nett-rent of 98*l.* which multiplied by 12,948 (the sum in the table corresponding with 35 years) gives 1268*l.* 18*s.*

To find the annual rent corresponding to any given sum paid for a lease, divide the sum by the number of years purchase in the table against the term of the lease; and under the rate of interest intended to be made of the purchase money; the quotient will be the annual rent required.

Example. A person is asked 1250*l.* for a lease of 30 years, what annual rent is equivalent thereto, allowing the purchaser to make 6 per cent. interest of his money? Divide 1250*l.* by 13,765, the years purchase in the table, under 6 per cent. interest, and the answer is 90*l.* 16*s.* 2*d.*

It frequently happens that a tenant is desirous of having the term of his lease renewed before the old lease expires; and if the estate has increased in value since it has been in his possession; it is common, in such cases, for the landlord to demand either an increase of the rent, or a gross sum called a fine, to be paid down in one immediate payment for such renewal. In many leases, particularly those held of colleges and other public bodies, it is covenanted that renewals shall be granted at the end of a certain number of years, on payment of a fine to be then agreed upon between the parties; the annual rent of the estate continuing the same. This fine is often a subject of dispute, arising principally from a difference of opinion respecting the improved annual value of the estate, or respecting the rate of interest, which each party is endeavouring to make of his money. The former, in some cases, is liable to uncertainty; but, if the latter is once agreed upon, the value of the fine, which ought to be given for renewing a lease of any yearly rent, can, in all cases, be exactly determined.

It is well known that when a lease is intended to be renewed, such lease is surrendered or delivered up, and a new lease of the estate is granted for a term of years which includes both the unexpired term of the old lease, and the additional term proposed to be renewed. Now the value which ought to be given for the grant of such additional term, will evidently be equal to the difference between the value of the lease for the whole term, and the value of the unexpired part thereof, of which the tenant is in actual possession: thus, if a person holds an unexpired term of twenty years in a lease, and is desirous of having ten years more added to it, or of having a new lease granted for the term of thirty years; the fine, or gross sum, which he ought to pay for such renewal will be equal to the difference between the value of a lease for the whole term of thirty years, and the value of a lease for the unexpired twenty years; this will be easily found from the preceding table.

Example. What fine ought to be given to the landlord for adding seven years more to a lease, of which 14 years are unexpired; allowing the tenant 6 per cent. interest for his money? The whole term for which the new lease is to be granted is 21 years, and the value of a lease for this term, is, by the table under 6 per cent. interest 11,764; the value of a lease for fourteen years is found in the same column to be 9,295, and this subtracted from the former sum leaves 2,469 for the number of years purchase which ought to be given for the fine required. If, therefore, the improved rent of the estate, or the present value beyond the rent payable under the lease, is 50*l.* per annum

this improved rent, multiplied by 2,469, will give 123*l.* 9*s.* for the amount of the fine required.

Leases are sometimes granted for a term of years certain, but subject to determine before that period if a particular life or lives should fail within the term; and the term of such leases being usually greater than the probable duration of the lives, the estate may be considered as wholly depending on the continuance of the life or lives nominated.

Life estates are of various kinds; some depend on a single life, of which kind may be considered church-livings, tenancies by courtesy, in dower, &c.; others are granted for two lives, such as joint-tenancies, and joint-tenancies with benefit of survivorship, the former signifying such estates as terminate on the death of either of the parties, and the latter signifying such as terminate on the death of both the parties; other estates are granted for three lives, which, like the last, may be divided into such as depend on the joint continuance of all the lives, and such as depend on the longest of all the lives; the former signifying such as terminate on the death of any one of the parties, and the latter such as terminate on the death of the longest liver of the three lives. When estates are held on two or three lives, and one of the lives, nominated in the lease, happens to drop, or become extinct, the tenant is often desirous of replacing such life, or of putting in a new life, in order that the estate may continue to be held on the same number of lives in being, and thereby his interest in the same be prolonged. In such cases it is customary, if the estate has improved in value since the original grant of the lease, for the landlord to demand a fine, or sum of money, proportionate to such improved value, and to the age of the person intended to be put to it, or added to those already in possession; the annual rent of the estate continuing the same. It is evidently the interest of the tenant, in this case, to add one of the best lives he can find, that is, a life which has the greatest expectation of living, according to the best tables of mortality, and such a life will be about the age of eight or ten years. However, it will sometimes happen that he may wish to put in a life not exactly of this age, but as it is his interest to put in as good a life as possible, few persons will be disposed to put in one above the age of twenty. The following table will, therefore comprehend the cases of this kind which most commonly occur, from which, the sums to be paid for renewing with a life of any other age may be nearly determined.

TABLE, for renewing, with One Life, the Lease of an Estate held on Three Lives Interest at 6 per Cent.

Life put in.	Lives in Possession.	Years Purchase.	Life put in.	Lives in Possession.	Years Purchase.	Life put in.	Lives in Possession.	Years Purchase.
	30-30	1.305		30-30	1.191		30-30	1.079
	30-40	1.521		30-40	1.407		30-40	1.284
	30-50	1.832		30-50	1.699		30-50	1.557
	30-60	2.160		30-60	1.996		30-60	1.831
	30-70	2.535		30-70	2.381		30-70	2.218
	30-75	2.571		30-75	2.408		30-75	2.241
	40-40	1.792		40-40	1.687		40-40	1.558
	40-50	2.204		40-50	2.067		40-50	1.908
	40-60	2.637		40-60	2.474		40-60	2.293
10	40-70	3.032	15	40-70	2.839	20	40-70	2.641
	40-75	3.273		40-75	3.076		40-75	2.873
	50-50	3.723		50-50	2.536		50-50	2.341
	50-60	3.242		50-60	3.039		50-60	2.828
	50-70	3.819		50-70	3.579		50-70	3.337
	50-75	4.062		50-75	3.819		50-75	3.576
	60-60	3.911		60-60	3.678		60-60	3.453
	60-70	4.917		60-70	4.627		60-70	4.338
	60-75	5.142		60-75	4.849		60-75	4.558
	70-70	6.124		70-70	5.805		70-70	5.489

The years purchase in the table multiplied by the improved annual value of the estate beyond the rent payable under the lease, gives the fine to be paid for putting in the new life.

Lease, in law, otherwise called a **Demise**, is a conveyance or letting of lands or tenements, in consideration of rent, or other annual recompense made for life, for years, or at will; but always for a less time than the interest of the lessor in the premises; for if it were of the whole interest, it would be more properly an assignment. He that demises or lets, is the lessor; and he to whom it is demised or let, is the lessee.

A lease may either be made by writing or word of mouth, called in law, a lease by parol. The former is most usual; but by the statute of frauds, 29 Charles II. c. 3, all leases of lands, except leases not exceeding three years, must be made in writing, and signed by the parties themselves, or their agents duly authorized, otherwise they will operate only as leases at will. If a lease is but for half a year, or a quarter, or less time, the lessee is respected as a tenant for years; a year being the shortest term of which the law, in this case, takes notice: that is, he is entitled to the general privileges of a tenant for years, and is classed as such, though his term lasts only for the time specified.

To constitute a good lease, there must be a lessor not restrained from making the lease to the extent for which it it granted; a lessee capable of receiving it; and the interest demised must be a demisable interest, and be sufficiently and properly described. If it is for years, it must have a certain commencement and determination; it is to have all the usual ceremonies, as sealing, delivery, &c.; and there must be an acceptance of the thing demised.

Leases were formerly only to a sort of bailiffs, who tilled the land, and paid a part of the profits to the landlord; they were for very short terms, and the tenant's estate was little respected in the law. They are now granted for long terms, and are very beneficial interests.

The following points may be necessary to be specified here concerning leases. First, they must have a certain commencement and end. Leases for life must not be made to commence at a future day, and there must be a livery of seisin. They must now be stamped as a lease, to be valid; and any form of writing will constitute a lease, provided it contains words of present demise, or actual letting; but if it be only an agreement to let, it conveys no immediate title in law, but only an equitable right to have a lease, or to sue at law for not making one. If a lease is made to one for years, and at the same time to another for a longer time, the last lease is not void, but shall take effect after the first expires. A tenant for life can, in general, only grant a lease to enure during his life; but sometimes a power is annexed to such an estate, to grant leases for a specified time, and under particular limitations, all which must be strictly complied with, or the lease is void; and instances have happened, where building-leases have been set aside, and persons ruined by having granted under-leases. An infant may make a lease; but may set it aside when he comes of age; and the Court of Chancery is empowered to grant leases for idiots, lunatics, infants, and married women.

The rent must be reserved to the executor or the heir of the lessor, according as his estate is real or personal. Lessees are bound to repair, unless the contrary is specified; and although if the house is burnt by accident they are not bound to rebuild, yet they must if the fire be by negligence; and if there is a covenant to pay rent, and a covenant to repair, except in case of fire, yet rent is payable, although the house is not rebuilt by the landlord. If there is a covenant not to assign, lease, or under-let, without licence of the landlord, the tenant cannot even grant an under-lease.

Upon a lease at will, six months' notice to quit must generally be given by either party, to determine on the same day in the year when the lease commenced. Leases made by spiritual persons of their church-lands, must be strictly conformable to certain statutes called the enabling and disabling statutes. The tenant may, at the trial of an ejectment, insist upon his notice to quit being insufficient, although he made no objection when it was served. See further Jacob's "Law Dictionary," title Leases.

Lease and Release, a conveyance of the fee simple, right, or interest, in lands or tenements, under the statute of uses, 27 Henry VIII. c. 10, giving first the possession, and afterwards the interest, which in law is equivalent to a feoffment. It was invented to supply the place of livery of seisin, and is thus contrived; a lease, or rather bargain and sale, upon some pecuniary consideration, for one year, is made by the tenant of the freehold to the lessee or purchaser, which vests in him the use of the term for a year; and then the statute of uses, 27 Henry VIII. c. 10, immediately

transfers the use into possession. He therefore being thus in possession, is capable of receiving a release of the freehold and reversion; and accordingly, the next day a release is granted to him.

This conveyance was invented by Serjeant Moore, soon after the statute of uses, and the principle upon which it is founded has been properly questioned, there being no actual entry in general under the lease, before the release is made. When a corporation conveys, either a feoffment or actual entry is still necessary. But this mode of conveyance having been long adopted, and in constant practice, its validity cannot now be questioned. This conveyance does not properly operate, unless there is either an actual entry, or a lease with a valuable consideration, as a bargain and sale for a year.

LEATHER, the skin of several sorts of beasts dressed and prepared for the use of the various manufacturers, whose business it is to make them up. The butcher and others, who flay off their hides or skin, dispose of them raw or salted to the tanner and tawyer, and they to the shamoy, morocco, and other kind of leather-dressers, who prepare them according to their respective arts, in order to dispose of them among the curriers, glovers, harness-makers, coach-makers, saddlers, breeches-makers, gilt leather-makers, chair-makers, shoe-makers, book-binders, and all in any way concerned in the article of leather.

The three principal assortments of leather are tanned or tawed, and oil and alum-leather; and it may be affirmed, with great truth, that the skins of our own production, and those imported from our colonies, when dressed in this kingdom, make the best leather in the world, and that therefore this is an article of great importance to the trade of the nation.

Though there is no little difference between the dressing of shamoy-leather, alum-leather, Hungary leather, Morocco leather, parchment, and tanning; yet the skins which pass through the hands of these several workmen, ought to have been for the most part, at least, washed clean from blood and impurities in a running water; set to drain, worked with the hands, or pounded with wooden pestles in a vat; put into the pit (which is a hole lined either with wood, or with stone and mortar) filled with water in which quick-lime is dissolved, in order to loosen the hair, that it may be easily rubbed off without injuring the skin; drawn out, and set to drain on the edge of the pit; stretched on the leg or horse, in order to have the hair scraped off with a blunt iron knife, or wooden cylinder: the membranes on the fleshy side, and the scabs or roughness on the grain side, pared off with a sharp knife, and the skins rubbed with a whetstone, to take off any particles of the lime, or any thing else that may occasion hardness; thickened by different sorts of powder, whereby they become greater in bulk, and so much lighter, as gradually to rise to the surface of the water; stretched out green or half dried, and piled one over another; or put up separate after they are dried, and hung out to air upon poles, lines, or any other way: which must be repeatedly done in the dressing of small skins. This alternate transition from the liquid of the air into that of water, and from water into the air, with the assistance of lime, salts, and oils, opens the inmost fibres of the skin so effectually, as greatly to facilitate the introduction of substances proper for making them pliant without rendering them thinner.

The alum-leather dresser dresses all sorts of white leather, from the ox-hide to the lamb-skin; for dressing the saddler's leather, he uses bran, sea-salt, and alum; and for that which the glover uses, after the common preparatives, he first employs bran, and then with salt, alum, fine flour, and yolks of eggs mixed in hot water, he makes a sort of pap, with which the skins are smeared in a trough. The shamoy leather-dresser soaks in oil, not only the skins of the true shamoy, which is a wild goat, but likewise those of all other goats. The tanner uses the bark of young oaks ground in a tanning mill, in which he soaks the skins more or less, according to the different services expected from them, their chief use being to remain firm and keep out water. In certain cases, instead of tan, he uses redon, which is chiefly used for tanning ram, sheep-skins, and dressing Russia leather. But for the different methods in which the tanner, currier, Russia, and Morocco leather-dressers proceed in finishing their skins, see CURRYING, TANNING, &c.

LEAVEN. See BREAD.

LECHEA, in botany, so named from John Leche, professor at Aboa, in Sweden, a genus of the Triandria Trigynia class and order. Natural order of Caryophyllei. Essential character: calyx three-leaved; petals three, linear; capsule three-celled, three-valved, with as many internal ones; seeds solitary. There are three species, natives

of North America, and of China near Canton.

LECYTHIS, in botany, a genus of the Polyandria Monogynia class and order. Natural order of Myrti, Jussieu. Essential character: calyx six-leaved; corolla six-petalled; nectary ligulate, staminiferous; pericarpium circumcised, many-seeded. There are six species. These are trees or shrubs, with alternate leaves; flowers in terminating spikes from the axils of the shoots. It is peculiar to this genus to have a pitcher-shaped body in the centre of the flower, which Linnæus calls the nectarium, inserted into the calyx below the petals, perforated in the middle for the passage of the style, shaped like a petal, coriaceous entire at the edge, but covered on the inside with numerous subsessile stamens. Native of the forests of Guiana.

LEDUM, in botany, a genus of the Decandria Monogynia class and order. Natural order of Bicornes. Rhododendra, Jussieu. Essential character: calyx five-cleft; corolla flat, five-parted; capsule five-celled, gaping at the base. There are three species, all natives of the North of Europe. These shrubs growing on mosses or bogs, where the roots spread freely, cannot be preserved in gardens, at least so as to thrive, but in a proper soil and a shady situation.

LEE, an epithet to distinguish that half of the horizon to which the wind is directed from the other part whence it arises, which latter is accordingly called to windward. This expression is chiefly used when the wind crosses the line of a ship's course, so that all on one side of her is called to windward, and all on the opposite side to leeward; and hence "Lee side," all that part of a ship or boat which lies between the mast and the side farthest from the direction of the wind; or that half of a ship which is pressed down towards the water by the effort of the sails, as separated from the other half by a line drawn through the middle of her length: that part of the ship which lies to the windward of this line is accordingly called the weather side. Thus, if a ship sail southward with the wind at east, then is her starboard, or right side, the lee-side; and the larboard, or left, the weather-side.

LEE *way*, or LEEWARD *way*, is the lateral movement of a ship to the leeward of her course, or the angle which the line of her way makes with her keel when she is close hauled. This movement is produced by the mutual effort of the wind and sea upon her side, forcing her to leeward of the line upon which she appears to sail, and in this situation her course is necessarily a compound of the two motions by which she is impelled. All ships are apt to make some lee-way; so that in casting up the log-book something must be allowed for lee-way. But the lee-way made by different ships, under the same circumstances, will be different: and even the same ship, with different lading, and having more or less sail on board, will make more or less lee-way.

However, the common allowances made for lee-way, are these: 1. If the ship be close hauled, has all her sails set, the water smooth, and a moderate gale of wind, she is supposed to make little or no lee-way. 2. If it blow so fresh, as to cause the small sails to be handed, it is usual to allow one point. 3. If it blow so hard, that the tops must be close reefed, the ship then makes about two points lee-way. 4. If one top-sail must be handed, it is common to allow two and three quarters, or three points lee-way. 5. When both topsails must be handed, they allow about four points lee-way. 6. When it blows so hard, as to occasion the fore-course to be handed, the allowance is between five and a half and six points. 7. When both main and fore-courses must be handed, then six, or six and a half points must be allowed for her lee-way. 8. When the mizen is handed, and the ship is trying a hull, she then makes her way good about one point before the beam, that is, about seven points lee-way.

Though these rules are such as are generally used, yet as the lee-way depends much upon the mould and trim of the ship, we shall here give the method of ascertaining it by observation. Thus, let the ship's wake be set by a compass in the poop, and the opposite rhumb is the true course made good by the ship; then the difference between this and the course given by the compass in the bittacle, is the lee-way required. If the ship be within sight of land, the lee-way may be exactly found by observing a point on the land which continues to bear the same way; for the distance between the point of the compass it lies on, and the point the ship capes at, will be the lee-way.

LEEA, in botany, so called from James Lee, a genus of the Pentandria Monogynia class and order. Natural order of Trihilatæ. Sapotæ, Jussieu. Essential character: corolla one-petalled; nectary on the

tube of the corolla, upright, five-cleft; berry five-seeded. There are three species, natives of the East Indies, Africa, and New South Wales.

LEECH. See HIRUDO.

LEEK. See ALLIUM.

LEERSIA, in botany, so named from John Daniel Leers, a genus of the Triandria Digynia class and order. Natural order of Gramina or Grasses. Essential character: calyx none; glume two-valved, closed. There are three species.

LEGACY, is a bequest of a sum of money, or any personal effects of a testator, and these are to be paid by his representative, after all the debts of the deceased are discharged as far as the assets, or property liable to payment of debts and legacies, will extend. All the goods and chattels of the deceased are by law vested in the representative, who is bound to see whether there be left a sufficient fund to pay the debts of the testator, which, if it should prove inadequate, the pecuniary legacies must proportionably abate; a specific legacy, however, is not to abate unless there be insufficient without it to pay debts, that is, the general legacies must all be exhausted first. If the legatee die before the testator, it will in general be a lapsed legacy, and fall into the general fund, as it will also where it is given upon a contingency, as to A B, if he shall attain twenty-one. Where, however, from the general import of the will, it can be collected that the testator intended it a vested legacy, it will go to the representative of the deceased legatee. Thus, if a legacy is made payable, or to be paid, to the legatee at a certain age, and he die, under that age, it is a vested and transmissible interest in him; but it is otherwise if it is generally to him at or when he attains such age. If the legacy is to bear interest, it is vested though the words payable are omitted. So, if it is to A for life, and after the death of A to B, the legacy to B is vested in B upon the death of the testator, and will not lapse by the death of B in the lifetime of A.

In case of a vested legacy due immediately, and charged on land, or money in the funds, which yields an immediate profit, interest shall be payable from the death of the testator; but if it be charged on the personal estate only of the testator, which cannot be collected in, it will carry interest only from the end of the year after the death of the testator. A legacy to an infant ought not to be paid to his father; a legacy to a married woman can only be paid to her husband; and executors are not bound to pay a legacy without security to refund.

When all the debts and particular legacies are discharged, the residue or surplus must be paid to the residuary legatee, if any be so appointed in the will; but if there be none appointed or intended, it will go to the executor or next of kin. When this residue does not go to the executor, it is to be distributed among the intestate's next of kin, according to the statute of distributions, except it is otherwise disposeable by particular customs, as those of London, York, &c. See EXECUTOR.

LEGNOTIS, in botany, a genus of the Polyandria Monogynia class and order. Essential character: calyx five-cleft; petals five, jagged, inserted into the receptacle; capsule three-celled. There are two species, viz. L. elliptica and L. cassipourea.

LEGUMEN, in botany, that species of seed-vessel termed a pod, in which the seeds are fastened along one suture only. In this the seed-vessel in question differs from the other kind of pod, termed by botanists siliqua, in which the enclosed seeds are fastened alternately to both the sutures or joinings of the valves. The seed-vessel of all the pea-bloom or butterfly-shaped flowers, the Diadelphia of Linnæus, is of the leguminous kind; such is the seed-vessel of the pea, vetch, lupine, &c. See PAPILIONACEOUS.

LEIBNITZ (GODFREY WILLIAM), an eminent mathematician and philosopher, was born at Leipsic, in Saxony, in 1646. At the age of fifteen, he applied himself to mathematics at Leipsic and Jena; and in 1663, maintained a thesis de Principiis Individuationis. The year following he was admitted Master of Arts. He read with great attention the Greek philosophers, and endeavoured to reconcile Plato with Aristotle, as he afterwards did Aristotle with Des Cartes. But the study of the law was his principal view; in which faculty he was admitted Bachelor in 1665. The year following he would have taken the degree of Doctor, but was refused it on pretence that he was too young; though, in reality, because he had raised himself many enemies by rejecting the principles of Aristotle and the schoolmen.

Upon this he repaired to Altorf, where he maintained a thesis de Casibus Perplexis with such applause, that he had the degree of Doctor conferred on him.

In 1672 he went to Paris, to manage some affairs at the French court for the Ba-

ron Boineboung. Here he became acquainted with all the literati, and made further and considerable progress in the study of mathematics and philosophy; chiefly, as he says, by the works of Pascal, Gregory, St. Vincent, and Huygens. In this course, having observed the imperfections of Pascal's arithmetical machine, he invented a new one, as he called it, which was approved by the minister Colbert and the Academy of Sciences, in which he was offered a seat as a member, but refused the offers made to him, as it would have been necessary to have embraced the Catholic religion.

In 1673 he came over to England, where he became acquainted with Mr. Oldenburgh, Secretary to the Royal Society, and Mr. John Collins, a distinguished member of that society; from whom, it seems, he received some hints of the method of fluxions, which had been invented in 1664, or 1665, by the then Mr. Isaac Newton.

The same year he returned to France, where he resided till 1676, when he again passed through England and Holland, in his journey to Hanover, where he proposed to settle. On his arrival there, he applied himself to enrich the Duke's library with the best books of all kinds. The Duke dying in 1679, his successor, Ernest Augustus, then bishop of Osnaburg, shewed M. Leibnitz the same favour as his predecessor had done, and engaged him to write the history of the House of Brunswick. To execute this task, he travelled over Germany and Italy to collect materials. While he was in Italy he met with a pleasant adventure, that might have proved a more serious affair. Passing in a small bark from Venice to Messola, a storm arose; during which the pilot, imagining he was not understood by a German, whom, being a heretic, he looked on as the cause of the tempest, proposed to strip him of his clothes and money, and to throw him overboard. Leibnitz, hearing this, without discovering the least emotion, drew a set of beads from his pocket, and began turning them over with great seeming devotion. The artifice succeeded; one of the sailors observing to the pilot, that since the man was no heretic, he ought not to be drowned.

In 1700 he was admitted a member of the Royal Academy of Sciences at Paris. The same year the Elector of Brandenburg, afterwards King of Prussia, founded an academy at Berlin by his advice; and he was appointed perpetual President, though his affairs would not permit him to reside constantly at that place. He projected an academy of the same kind at Dresden: and this design would have been executed, if it had not been prevented by the confusions in Poland. He was engaged likewise in a scheme for an universal language, and other literary projects. Indeed his writings had made him long before famous all over Europe, and he had many honours and rewards conferred on him. Beside the office of Privy Counsellor of Justice, which the Elector of Hanover had given him, the Emperor appointed him, in 1711, Aulic Counsellor; and the Czar made him Privy Counsellor of Justice, with a pension of 1,000 ducats. Leibnitz undertook, at the same time, to establish an academy of sciences at Vienna; but the plague prevented the execution of it. However the Emperor, as a mark of his favour, settled a pension on him of 2,000 florins, and promised him one of 4,000, if he would come and reside at Vienna; an offer he was inclined to comply with, but was prevented by the death of that prince.

Meanwhile, the History of Brunswick being interrupted by other works, which he wrote occasionally, he found, at his return to Hanover in 1714, that the Elector had appointed Mr. Eccard for his colleague in writing that history. The Elector was then raised to the throne of Great Britain, which place Leibnitz visited the latter end of that year, when he received particular marks of friendship from the King, and was frequently at court. He now was engaged in a dispute with Dr. Samuel Clarke, upon the subjects of free-will, the reality of space, and other philosophical subjects. This was conducted with great candour and learning, and the papers which were published by Clarke will ever be esteemed by men of genius and learning. The controversy ended only with the death of Leibnitz, November 14, 1716, which was occasioned by the gout and stone, in the 70th year of his age.

As to his character and person: he was of a middle stature and a thin habit of body. He had a studious air, and a sweet aspect, though near-sighted. He was indefatigably industrious to the end of his life. He eat and drank little. Hunger alone marked the time of his meals, and his diet was plain and strong. He had a very good memory, and it is said, could repeat the Æneid from beginning to end. What he wanted to remember he wrote down, and never read it afterwards. He always professed the Lu-

-theran religion; but he never went to sermons; and when in his last sickness his favourite servant desired to send for a minister, he would not permit it, saying he had no occasion for one. He was never married, nor ever attempted it but once, when he was about fifty years old; and the lady desiring time to consider of it, gave him time to do the same: he used to say, "that marriage was a good thing; but a wise man ought to consider of it all his life."

Leibnitz was author of a great multitude of writings, several of which were published separately, and many others in the memoirs of different academies. He invented a binary arithmetic, and many other ingenious matters. His claim to the invention of fluxions was the subject of much controversy, for which the authors of the time may be consulted.

Hanschius collected with great care every thing which Leibnitz had said in different passages of his works on the principles of philosophy; and formed of them a complete system, under the title of "G. G. Leibnitzii Principia Philosophiæ more geometrico demonstrata, &c." 1728, in 4to. There came out a collection of our Author's letters in 1734 and 1735, entitled "Epistolæ ad diversos theologici, juridici, medici, philosophici, mathematici, historici, et philologici augmentile MSS. auctores: cum annotationibus suis primum divulgavit Christian Cortholtus." But all his works were collected and distributed into classes by M. Dutens, and published at Geneva in six large volumes 4to., in 1768, intitled "Gothofredi Gulielmi Leibnitzii Opera Omnia, &c."

LEMMA, in mathematics, denotes a previous proposition, laid down in order to clear the way for some following demonstration; and prefixed either to theorems, in order to render their demonstration less perplexed and intricate, or to problems, to make their resolution more easy and short. Thus, to prove a pyramid one-third of a prism, or parellelopiped, of the same base and height with it, the demonstration whereof, in the ordinary way, is difficult and troublesome, this lemma may be premised, which is proved in the rules of progression, that the sum of the series of the squares, in numbers in arithmetical progression, beginning from 0, and going on 1, 4, 9, 16, 25, 36, &c., is always subtriple of the sum of as many terms, each equal to the greatest; or is always one-third of the greatest term multiplied by the number of terms. Thus, to find the inflection of a curve line, this lemma is first premised, that a tangent may be drawn to the given curve in a given point.

LEMNA, in botany, a genus of the Monoecia Diandria class and order. Natural order of Miscellaneæ. Naiades, Jussieu. Essential character: male, calyx one leafed; corolla none: female, calyx one-leafed; corolla none; style one; capsule one-celled. There are six species. These plants are well known by the name of "duck's meat," or "duck weed." They are all annuals, and are found floating on stagnant water. They are natives of most parts of Europe, in ditches, ponds, &c.

LEMNISCIA, in botany, a genus of the Polyandria Monogynia class and order. Essential character: calyx five-toothed; corolla five-petalled, recurved; nectary cup-shaped, girding the germ; pericarpium five-celled; seeds solitary. There is but one species, *viz.* L. guianensis. The trunk of this tree is about twenty feet in height, and one foot in diameter; the bark is brown and smooth; the wood is white and compact; abundance of twisted branches spread in every direction; leaves alternate, firm, and smooth; flowers at the ends of the shoot, very numerous, in large corymbs, on a woody peduncle: corolla of a fine coral red. Native of Guiana.

LEMON. See CITRUS.

LEMONS, *salt of*, used to remove ink-stains from linen, is the native salt of sorrel, the super-oxalate of potash. The effect is produced by the oxalic acid dissolving with facility the oxide of iron in the ink, on the combination of which with the tannin and gallic acid the colour depends; while, at the same time, it can be used without any risk of injury to the cloth, on which it has no effect. See OXALATE.

LEMONADE, a liquor prepared of water, sugar, and lemon or citron juice. It is very cooling and grateful.

LEMUR, the *macauco*, in natural history, a genus of Mammalia, of the order Primates. Generic character: in the upper jaw four front teeth, the intermediate ones remote; in the lower jaw six, longer, extended forwards, compressed, parallel, and approximated; tusks solitary and approximated; grinders several, and sometimes many, sublobated, the foremost somewhat longer and sharper. This genus of animals is very similar to that of monkeys in the structure of the feet. Some are destitute of a tail, and others have extraordinary

long ones. Their manners are very different from those of monkeys, and display nothing of the active mischief and intrusive impertinence of that animal. There are thirteen species, of which we shall notice the following:

L. tardigradus, or the loris. This is of a light brown colour, and of the usual size of a cat. It walks and climbs with great slowness, and is supposed incapable of leaping. Its manners are gentle and interesting, it is extremely susceptible of cold, and when exposed to a strong degree of it is agitated with extreme uneasiness, and with considerable exasperation. It sleeps from sunrise to sun-set without intermission, rolled up in the manner of the hedge-hog; it is extremely attentive to cleanliness, licking its full and rich fur with the same assiduity as a cat. Its food consists of plantains, mangoes, and other fruits, and it is scarcely capable of satisfying itself with grasshoppers when it has access to them. Many species of insects, indeed, form a repast particularly gratifying to it, and the sight of them excites in its look the most glowing animation, and summons to exertion all the energies of its frame. Several of the above particulars are taken from an account given of one kept in a state of confinement by the late Sir William Jones. It is a native of various parts of India.

L. indri, is a native of Madagascar, is the largest of the genus, has a face of a dog-like form, and a fur thick and soft. It has no appearance of a tail: it is very docile, and sometimes trained by the natives to hunt various animals. It is three feet and a half in height.

L. macanco, or the ruffed macanco, is found in some of the Indian islands, and is particularly numerous at Madagascar. It is full of energy and fierceness, and its voice is so strong as to fill the woods with its cries. It will endure captivity, notwithstanding the violent passions it exhibits in a natural state, without discontent or depression, and is stated to be extremely inoffensive, and even sociable in it, with those by whom it is surrounded. It possesses neither craft nor malice in it.

L. catta, or the ring-tailed macanco. In their state of nature these animals are seen in companies of twenty or thirty. They feed on almost every species of fruits, and, in a state of confinement, like several others of this genus, will take animal food without any hesitation. They are the most elegant and beautiful species of the whole genus, are lively and gentle, and so agile and elegant in their movements, as to be highly interesting. They delight much in sunshine, and will sit before a fire, like the squirrel, extending towards it their outspread hands. It inhabits Madagascar, is of the size of a small cat, and resembles that animal in purring. See Mammalia, Plate XV. fig. 1 and 2.

LENS, in dioptrics, properly signifies a small roundish glass, of the figure of a lentil; but is extended to any optic glass, not very thick, which either collects the rays of light into a point, in their passage through it, or disperses them further apart, according to the laws of refraction.

Lenses have various figures, that is, are terminated by various surfaces, from which they acquire various names. Some are plane on one side, and convex on the other; others convex on both sides, both which are ordinarily called convex lenses: though where we speak accurately, the former is called plano-convex. Again, some are plane on one side, and concave on the other; and others are concave on both sides; which are both usually ranked among the concave lenses; though, when distinguished, the former is called a plano-concave. Others, again, are concave on one side, and convex on the other, which are called convexo-concave, or concavo-convex lenses, according as the one or the other surface is more concave, or a portion of a less sphere. It is here to be observed, that in every lens terminated in any of the forementioned manners, a right line, perpendicular to the two surfaces, is called the axis of the lens; which axis, when both surfaces are spherical, passes through both their centres; but if one of them be plane, it falls perpendicularly upon that, and goes through the centre of the other. See Optics.

LEO, in astronomy, one of the twelve signs of the zodiac, the fifth in order. See Astronomy.

LEONTICE, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Corydales. Berberides, Jussieu. Essential character: calyx six-leaved, deciduous; corolla six-petalled; nectary six-leaved, placed on the claws of the corolla, spreading. There are three species.

LEONTODON, in botany, *dandelion*, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ Semiflosculosi. Cichoraceæ, Jussieu. Essential character: calyx imbricate, with

loosish scales; down capillary; receptacle naked, dotted. There are four species, of which L. taraxacum, dandelion, is common all over Europe, in meadows, on walls, dry banks, &c.; it flowers from April to September; the flowers expand about five or six in the morning, closing early in the afternoon; as the flower advances, the calyx is gradually pressed out at top, and when the flowering is past, it contracts again into a conical form, and finally when the seeds are mature, the calyx is again pushed back, and the aggregate of down assumes a spherical form, till the whole is loosened and dissipated by the wind.

LEONORUS, in botany, *lion's tail*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: anthers having shining dots sprinkled over them. There are five species.

LEPAS, in natural history, *acorn-shell*, a genus of the Vermes Testacea class and order. Animal a triton; shell affixed at the base, and consisting of many unequal, erect valves. There are upwards of thirty species. L. balanus, shell conic, grooved; operculum or lid, sharp-pointed: it inhabits the European and Mediterranean seas, adhering in the greatest abundance to rocks, shells, &c.; generally whitish; with about six outer valves, three of which are elevated and striate, and three excavated and smoother; the pieces composing the lid, are finely crenate with transverse wrinkles, two lesser and two larger, and pointed. L. anatifera, duck-barnacle, shell compressed, five-valved, smooth, seated on a peduncle: of this there are several varieties, which inhabit most seas; they are generally found fixed in clusters to the bottoms of vessels and old pieces of floating timber; whitish, with a blue cast, the margins of the valves yellow, sometimes marked with a ray or two dotted with black; peduncle long, coriaceous, black, and very much wrinkled towards the shell, and growing paler and pellucid towards the base, extensile; sometimes, though not often, red. The tentacula are feathered, which gave the old English naturalists the idea of a bird. They ascribed the origin of the barnacle-goose to these shells.

LEPIDIUM, in botany, *pepper-wort*, a genus of the Tetradynamia Siliculosa class and order. Natural order of Siliquosæ, or Cruciformes. Cruciferæ, Jussieu. Essential character: silicle emarginate, cordate, many-seeded; valves keeled, contrary. There are twenty-three species, of which L. perfoliatum, various-leaved pepper-wort, is an annual plant, about a foot in height; the stem is round, upright, and smooth, tinged with purple, dividing into many slender branches; flowers in corymbs, or long, loose spikes, from the ends of the branches; silicles orbiculate, scarcely emarginate, and the terminating style so short as to be hardly visible. It is a native of Austria and the Levant.

LEPIDOPTERA, or *scaly-winged*, the third order of insects, according to the Linnæan system. The general character of this order is four wings, covered with fine imbricate scales; tongue involute, spiral; body hairy. It consists of the insects commonly termed butterflies and moths. There are three genera, *viz.*

Papilio Sphinx
Phalæna

The powder on the wings of these insects has been generally described by microscopical writers as consisting of small feathers; but they are more in the form of minute scales, of various shapes and sizes, on the different species, and even on the different parts of the same animal. Their usual appearance is more or less fan-shaped, and they are disposed in the manner of tiles on a roof, lapping over each other. See PAPILIO, &c.

LEPISMA, in natural history, a genus of insects of the order Aptera; lip membranaceous, rounded, emarginate; four feelers, of which two are setaceous, and two capitate; antennæ setaceous; body imbricate, with scales; tail ending in setaceous bristles; six legs, formed for running. There are seven species enumerated, of these the principal is L. saccharina; scaly, silvery, lead-colour, with a triple tail. It inhabits America, among sugar, but is naturalized in Europe, and found among old books and furniture; it runs exceedingly swift, and is difficult to catch. In their various stages of existence these insects prey upon sugar, decayed wood, and rotten substances; the larva and pupa are six-footed, active, and swift.

LEPROSO *amovendo*, an ancient writ to remove a leper, who came to church or to public meetings to annoy his neighbours; but it could only lie when the party appeared outwardly unwholesome by his sores and smell, and if he kept at home it could not be enforced. It seems to have been a wise provision for the health of the public.

LEPTOCEPHALUS, the *morris*, in natural history, a genus of fishes of the order Apodes. Generic character: head small and narrow, body exceedingly thin, compressed; no pectoral fins. This fish was first discovered near the isle of Anglesea, by a gentleman of the name of Morris. It is four inches long, with an exceedingly small head, and a body so thin as to be nearly transparent; on a slight view it might almost be considered as a tape-worm.

LEPTOSPERMUM, in botany, a genus of the Icosandria Monogynia class and order. Natural order of Myrti. Essential character: calyx five-cleft, half superior; petals five, with claws, longer than the stamens; stigma capitate; capsule four or five-celled; seeds angular. There are eleven species, of which L. scoparinm is a small tree or shrub, growing to a moderate height, generally bare on the lower part, with a number of small branches growing close together towards the top; the younger ones are silky: it grows commonly in dry places near the shores in New Zealand; the underwood in Adventure-bay, Van Diemen's land, chiefly consists of this shrub; the leaves were used by Captain Cook's ships' crews, as tea, whence they named it the tea-plant; the leaves have a very agreeable flavour, and a pleasant smell when fresh; if the infusion was made strong, it proved an emetic to some, in the same manner as green tea; it was also used with spruce leaves, in equal quantities, to correct their astringency in brewing beer for them, which rendered it exceedingly palatable.

LEPTURA, in natural history, a genus of insects of the order Coleoptera. Antennæ setaceous; four feelers filiform; shells tapering towards the tip; thorax slender, rounded. There are nearly one hundred and fifty species, in two divisions, *viz*. A. lip entire; B. lip bifid. Many of the species of this genus are very beautiful; among these may be mentioned L. arcuata, of a black colour, with wing-sheaths marked by transverse yellow; lunated bands pointing backwards. It is found in the woods during the summer months, and generally measures about three-quarters of an inch in length. L. aquatica, is so named from its being particularly found in the neighbourhood of waters, frequently on the plants which grow near the water's edge. It is only half an inch in length, and of a golden green colour, sometimes varying into copper-colour, purple, or blue, and is distinguished by having a tooth or process on the thighs of the legs.

LEPUS, the *hare*, in natural history, a genus of Mammalia, of the order Glires. Generic character: two fore-teeth above and below; the upper pair double, two small ones standing within the exterior. These animals exhibit several considerable differences from those of the order Glires in general, to which, however, upon the whole, they are with more propriety attached than to any other. By an appearance of rumination, they appear somewhat connected with the Pecora. There are fifteen species, of which the following chiefly deserve notice.

L. timidus, or the common hare. This animal is a native of almost every country of the old continent, and is generally of the length of two feet. Its upper lip is divided, and its eyes are extremely projected, and, it is said, kept open by it during sleep. It subsists on a great variety of vegetables, particularly those which possess milky qualities; the bark of young trees, and their tender shoots, are likewise often taken by them for food. It produces generally three young ones at a time, and breeds at least three times in a year. The hare seldom quits its seat, or form, as it is called, during the day, unless compelled by the approach of enemies; but takes its range for food and excursion by night, always returning, it is said, to her habitation by the same track by which it was left. In this form it will sometimes suffer itself to be approached so nearly, as to be nearly trodden upon before it starts for escape; the first advances of the enemy having probably not attracted its attention, and those which immediately followed, being attended by a species of fascination, or prostration of energy, the frequent effect of terror, till, at length, the imminence of its danger rouses every nerve and muscle, to exertions which enable it to leave its enemies at a considerable distance. Its fleetness is such as to give it the advantage over many of its numerous adversaries. Its quickness of hearing, and comprehension of sight, by which last it receives the impressions of objects on almost every side, are also important means of its protection. The similarity of its colour, likewise, to that of the ground, is another circumstance considerably in its favour. In the more northern regions, during the rigours of winter, its coat becomes of a perfect whiteness. By the particular structure of the hind-feet of this animal, it is quali-

fied to run with rapidity up a considerable ascent, and seems to be conscious of this advantage, by frequently taking such a direction as gives it the full benefit of this peculiarity.

The average duration of the hare is about seven years; but so numerous are its enemies, that, notwithstanding the advantages above-mentioned, it very frequently fails to attain its natural term. It is pursued by dogs and foxes with mortal and unrelenting antipathy. Weasels, wild-cats, and wolves seize and devour it whenever it is within their reach; and eagles, hawks, and other birds of prey are also destructive enemies; but the most formidable of all is man, who finds one of the most interesting of his diversions in its persecution, and one of the highest luxuries of his table in its flesh. Indeed, so prolific is the hare, that without experiencing very considerable hostility, it would multiply to a most injurious degree; and in some districts of France, where the game was particularly and assiduously secured by the proprietors, no fewer than five hundred hares have been killed within a small compass in a single day.

The hare, if taken young, may be tamed and domesticated. It has occasionally been suckled and nursed by a cat. The celebrated Sonnini, the traveller and naturalist had a hare in a complete state of domestication; and Cowper, the poet, was in possession of three, whose comforts he attended to with the most humane assiduity, and whose manners he has described with much interest and discrimination. The fur of the hare is of eminent, and almost indispensable utility, in the hat manufactory, and innumerable skins are annually brought to this country for that purpose from the north of Europe.

This animal was regarded by Moses as unclean, and unfit for food; it is considered in the same light also by the Mahometans. The Romans used to value it highly for the table. By the ancient Britons it was considered as partaking somewhat of a sacred character, which forbade their application of it to so ordinary a purpose. Hares have been seen in this country perfectly white, as in more northern regions, and accounts of horned hares have been given to the public upon unquestionable authority, though such animals are of extremely rare occurrence. For the Common Hare, see Mammalia, Plate XV. fig. 3.

L. variabilis, or the varying hare, is an inhabitant of the loftiest territories of the north, both of Europe and America. Its colour in summer is a tawny grey, and in winter it is changed to a perfect white. It never associates with the common hare, and rarely descends from its elevated haunts into the vallies; though occasionally, in a rigorous winter, numbers of these animals are seen to quit the frozen elevations of Siberia, and migrate for subsistence to the woody and sheltered plains.

L. cuniculus, or the rabbit, is found in most temperate climates, but not far to the north. Its fecundity is extreme, and in some countries has occasioned it to be considered as one of the greatest annoyances. It will breed, in favourable circumstances, seven times in a year, and produces about eight young ones at a time. It is most strikingly similar to the hare in general appearance; but while the hare prefers the uncovered field, the rabbit burrows in the ground. It has sharp and long claws for this purpose, and chooses dry and chalky soils, in which it can with the greatest ease construct its mansion. It lives to the age of about eight years. The female prepares a bed for its young before their birth, from its own coat, of the finest and warmest materials, nurses them with incessant assiduity, and is obliged often to secrete them from the malignant attempts of the male, which have been known, in many instances, to be fatal to them. In England, particularly in Cambridgeshire and Norfolk, rabbits are abundant, and their fur is of nearly equal value with their flesh.

The hare and rabbit never intermix, and appear to contemplate each other without the slightest sympathy. The principal difference between these two animals consists in the proportional length of the hind legs to that of the back. For the Rabbit, see Mammalia, Plate XV. fig. 4.

L. alpinus, or the Alpine hare, is about the size of a Guinea pig, is a native of the Altaic mountains, and burrows in the clefts of the rocks, or resides in the hollows of trees. These animals avoid the glare of day, and appear only by night, or in obscure and dull weather. They collect in summer a preparation of herbage, the most delicate and fragrant, and having dried it with the utmost care, set it aside in compact heaps for their subsistence during winter. These heaps are occasionally of the height and depth of several feet, and are sometimes of extreme service to the horses of the sable hunters in those dreadful regions, preserving them from absolutely

starving, a fate, however, to which the little labourers are exposed in consequence of these depredations.

L. pusillus, inhabits the south-east of Russia, is solitary, and rarely to be observed, even where most abundant. It is only about six inches in length. It generally indicates its residence by its sounds, resembling those of a quail. Its pace consists of a succession of leaps, rather than steps. It sleeps with its eyes open, is particularly gentle, passes but little of its time in sleep, and is perfectly familiarized in the course of two or three days after it is taken.

LEPUS, in astronomy, a constellation of the southern hemisphere. See ASTRONOMY.

LERCHEA, in botany, so named in honour of John Lerche; a genus of the Monadelphia Pentandria class and order. Essential character: calyx five-toothed; corolla funnel-form, five-cleft; anthers five, placed on the tube of the germ; style one; capsule three-celled, many-seeded. There is but one species, viz. L. longicauda, native of the East Indies.

LERNEA, in natural history, a genus of the Vermes Mollusca class and order. Body oblong, somewhat cylindrical, naked; two or three tentacula each side and round, by which it affixes itself; two ovaries, projecting like tails from the lower extremity. These insects are without eyes, and are said to be very troublesome to fish, adhering very firmly principally to the gills and fins. There are fifteen species. L. meridiana is one of the largest European species, often measuring an inch in length, and is a very common insect during the decline of summer, generally appearing in the hottest part of the day. It is brown above; brilliant tawny beneath; shining like satin.

LESKIA, in botany, so named from Nathaniel Godofr. Leske, Professor of Natural History and Oeconomy, in the University of Leipsic; a genus of the Cryptogamia Musci class and order. Natural order of Mosses. Generic character: capsule oblong; peristome double; the exterior with sixteen teeth, which are acute; the interior membranaceous, divided into equal segments. Males, gemmaceous in different individuals.

LETHARGY, in medicine, a disease wherein such a profound drowsiness or sleepiness attends the patient, that he can be scarce awaked, and, if awaked he remains stupid, without sense or memory, and presently sinks again into his former sleep.

LETTER, a character used to express one of the simple sounds of the voice; and as the different simple sounds are expressed by different letters, these, by being differently compounded, become the visible signs or characters of all the modulations and mixtures of sounds used to express our ideas in a regular language. Thus, as by the help of speech we render our ideas audible, by the assistance of letters we render them visible, and by their help we can wrap up our thoughts, and send them to the most distant parts of the earth, and read the transactions of different ages. As to the first letters, what they were, who first invented them, and among what people they were first in use, there is still room to doubt: Philo attributes this great and noble invention to Abraham; Josephus, St. Irenæus, and others, to Enoch; Bibliander, to Adam; Eusebius, Clemens Alexandrinus, Cornelius Agrippa, and others, to Moses; Pomponius Mela, Herodian, Rufus Festus, Pliny, Lucan, &c. to the Phœnicians; St. Cyprian, to Saturn; Tacitus, to the Egyptians; some, to the Ethiopians; and others, to the Chinese: but, with respect to these last, they can never be entitled to this honour, since all their characters are the signs of words, formed without the use of letters; which renders it impossible to read and write their language without a vast expense of time and trouble; and absolutely impossible to print it by the help of types, or any other manner but by the engraving, or cutting in wood. See PRINTING.

There have also been various conjectures about the different kinds of letters used in different languages; thus, according to Crinitus, Moses invented the Hebrew letters; Abraham, the Syriac and Chaldee; the Phœnicians, those of Attica, brought into Greece by Cadmus, and from thence into Italy by the Pelasgians; Nicostrata, the Roman; Isis, the Egyptian; and Vulfilas, those of the Goths.

It is probable that the Egyptian hieroglyphics were the first manner of writing: but whether Cadmus and the Phœnicians learned the use of letters from the Egyptians, or from their neighbours of Judea or Samaria, is a question; for since some of the books of the Old Testament were then written, they are more likely to have given them the hint than the hieroglyphics of Egypt. But wheresoever the Phœnicians learned this art, it is generally agreed, that Cadmus, the son of Agenor, first brought letters into Greece; whence, in following ages, they spread over the rest of Europe.

Letters make the first part or elements of grammar; an assemblage of these compose syllables and words, and these compose sentences. The alphabet of every language consists of a number of letters, which ought each to have a different sound, figure, and use. As the difference of articulate sounds was intended to express the different ideas of the mind, so one letter was originally intended to signify only one sound, and not, as at present, to express sometimes one sound and sometimes another; which practice has brought a great deal of confusion into the languages, and rendered the learning of the modern tongues much more difficult than it would otherwise have been. This consideration, together with the deficiency of all the known alphabets, from their wanting some letters to express certain sounds, has occasioned several attempts towards an universal alphabet, to contain an enumeration of all such single sounds or letters as are used in any language. See ALPHABET, and WRITING, *origin of.*

Grammarians distinguish letters into vowels, consonants, mutes, liquids, diphthongs, and characteristics. They are also divided into labial, dental, guttural, and palatal, and into capital and small letters. They are also denominated from the shape and turn of the letters; and in writing are distinguished into different hands, as roundtext, German-text, round hand, Italian, &c. and in printing into roman, italic, and black letter. The term letter, or type, among printers, not only includes the capitals, small capitals, and small letters, but all the points, figures, and other marks, cast and used in printing; and also the large ornamental letters, cut in wood or metal, which take place of the illumined letters used in manuscripts. The letters used in printing are cast at the ends of small pieces of metal, about three quarters of an inch in length; and the letters being not indented, but raised, easily give the impression, when, after being blacked with a glutinous ink, paper is closely pressed upon it.

A fount of letters includes small letters, capitals, small capitals, points, figures, spaces, &c. but besides these they have different kinds of two-lined letters, only used for titles, and the beginning of books, chapters, &c. See FOUNT.

LETTER *of attorney*, a writing authorising another to do any lawful act instead of the party himself, such as to sue and recover debts, to receive rents, seamen's wages, to execute leases, to give livery of seisin, &c. In all these cases the authority must be strictly pursued, and it is liable to be revoked by granting a new letter of attorney, or by death of either party. In cases of seamen, there are certain statute regulations for protecting them from imposition.

LETTERS *of marque*, are extraordinary commissions, granted to captains or merchants for reprisals, in order to make a reparation for those damages they have sustained, or the goods they have been deprived of by strangers at sea. These appear to be always joined to those of reprise for the reparation of a private injury; but under a declared war the former only are granted.

LEVATOR, in anatomy, a name given to several muscles. See ANATOMY.

LEUCOIUM, in botany, *snow-drop*, a genus of the Hexandria Monogynia class and order. Natural order of Spathaceæ. Narcissi, Jussieu. Essential character: corolla bell-shaped, six-parted, thickened at the tips; stigma simple. There are four species: these are all bulbous rooted plants; the flowers, which at first sight resemble those of the common snow-drop, are easily distinguished by the absence of the three-leaved nectary, and they do not appear so soon by a month. These plants being of a different genus from the true snow-drop, ought certainly to have another English name: some botanists call it spring snow flake; others many-flowered bulbous violet. In the gardens it is known by the name of great summer snow-drop, and late or tall snow-drop. They are natives of the south of Europe.

LEUCOPHRA, in natural history, a genus of the Vermes Infusoria class and order: worm invisible to the naked eye, every where ciliate. There are eight species. L. cornuta: inversely conic, green, opaque. This is found in marshy grounds. Body broad, truncate on the fore part, with a small spine on each side; the hind part pellucid and pointed, sometimes it appears oval or kidney-shaped, and when the water which contains it evaporates, it breaks into molecular vesicles. L. nodulata; ovate-oblong, depressed, with a double row of tubercles. This species is found in the intestines of lumbricus terristris, and nais littoralis: it is very pellucid, shining like silver, and is propagated by a transverse division; oval when young, and growing more oblong with age; truncate at the tip.

LEUCOPSIS, in natural history, a genus of insects of the order Hymenoptera: mouth

horny, with short jaws, the mandible thick, and three toothed at the tip; lip longer than the jaw, membranaceous and emarginate at the tip; four feelers; short, equal, filiform; antennæ short, clavate; thorax with a long lanceolate scale beneath; wings folded; sting reflected, and concealed in a groove of the abdomen. There are four species, all foreign insects.

LEVEL, an instrument constructed for the purpose of ascertaining the exact level of any fluid, building, &c. Of these there are two distinct kinds, *viz.* the horizontal, and the perpendicular: the first sort, which comprises spirit and air levels, is chiefly in use among surveyors; the latter is ordinarily employed by artificers, and depends for exactness on a plumb line.

The instruments used by persons taking the levels of lands, waters, &c. whereby to ascertain the comparative heights of different spots, or tracts, are simple in the extreme, being generally made with a telescope of about fifteen inches long, fixed above a circular opening in a brass plate, so as to show a compass that traverses immediately below its centre, and gives not only the number of points, *i. e.* thirty-two, according to the mariner's division, but by means of a neat brass rim, graduated with three hundred and sixty degrees, divided into thirty-six portions of ten degrees each, and numbered, shows the exact angle made between any two sights taken by the telescope, which traverses on two legs, supported in grooves on the outer edge of the brass plate, and allowing it to move round in a direction perfectly parallel thereto. The plane thus described by the circular motion of the telescope is made to correspond with that of the horizon by the aid of a small brass tube, about six or eight inches in length, fixed exactly parallel with the line of sight through the telescope, and screwed to its cylinder in such manner as to remain firm. This little tube has on its upper side, or surface, an opening into which a piece of clear glass, corresponding with the cylindrical curve of the tube, is fitted and properly cemented. This piece of glass being perfectly centrical, serves to show how the fluid, generally alcohol (or pure spirits), with which the tube is filled, with the exception of a very minute portion, stand in respect of inclination with, or from the horizon. When the bubble of air left in the tube floats exactly centrical, in that portion which is covered with glass, the tube itself must be level; and as it is affixed at an exact parallel with the line of sight, which passes through the axis, or centre of the telescope, from the eye to the crossing of two hairs, at right angles, within the telescope, the instrument itself must then be level, and that part of any object, however distinct, which is cut or indicated by the line of sight, is ascertained by the centre of the cross made by the hairs being on a rectilinear level with the line of sight. But in consequence of the curvature of the earth's surface, the horizontal level will be different from the rectilinear level, and will describe an arc parallel with the surface of the earth. This curvature amounts to about eight inches in every mile; or, in more minute parts, may be taken at four and a half lines for every hundred yards.

The usual mode of taking a level is by means of a painted board, about a foot square, having a broad white stripe drawn horizontally across its centre. This board slides up and down a long pole, which being held perpendicularly by an assistant, at any appointed spot of which the level is to be ascertained, the instrument is brought to the exact direction in which the pole is situated; so that the latter may coincide, or as it is technically called, "be in one" with that basis which is vertical within the tube. The legs on which the level is supported, (generally the same as in theodolites, &c.) are spread so as to be firm; after bringing the compass as nearly as may be practicable to a level: by means of four screws, which serve to raise the different sides of the plate at pleasure, the utmost precision is attainable. The board is then moved up or down on the pole, which is marked all the way up in feet, inches, halves, and quarters, until the centre painted line "is in one" with the horizontal hair within the telescope. The height of the telescope above the surface on which it stands must be deducted from the number of feet and inches, at which the line on the board stands above the spot where the pole is fixed: the residue shows how much that is below the place where the instrument stands. But if the height of the line on the board be less than that at which the line of sight in the level stands from the ground, then the difference between those two heights will exhibit how much the former is above the latter.

By this simple mode the level of any intended land, &c. may be correctly taken, observing to limit the sight as much as

possible; indeed, it is always best to confine them to distances not exceeding three-hundred yards; because the difference between the rectilinear and the horizontal levels are then greatly diminished, and the whole survey will prove far more correct. This will be easily seen from the following sketch. (Plate VIII. Miscellanies, fig. 2). Let A B represent a sight taken at 2100 yards, and let A C be an equal distance measured on the surface of the segment A D, but broken off at every three-hundred yards, *i. e.* into seven portions: it must be obvious that the line B C will give a greater length than would result from the proportion already stated, the perpendicular falling so much beyond D; and that such difference would increase in its disproportions according as the range of sight might be enlarged. To prove this still more clearly, let us state that the quadrant O P (fig 3), of the earth's surface stands on a radius P S of four-thousand miles. Now the first taken from the summit O of that quadrant would be a parallel to that horizontal radius, and a tangent to the arc at its summit, as from O to X. It is evident that if a sight of four-thousand and one miles could be taken in the direction O X, a perpendicular falling from X, would not even touch the point P, from which it would be a mile distant. It is true, that our sights are not to be compared with the foregoing extents; but it is equally true, that we verge towards the error above shown when we take too long sights.

Perhaps nothing can be more deceptive than the common mode of estimating levels: more than once we have witnessed the opinions of smatterers in this branch of surveying, who having levelled the instrument with great exactness, and directed the telescope to a very distant hill, on seeing the point of intersection cut near its summit, have concluded the spot so indicated to be on a level with that where the instrument stood. This mis conception arises purely from a long rectilinear sight, without considering that the base of a remote hill is a plane whose surface stands at a very great angle from that on which the level is placed; as shown by the dotted lines representing a hill R intercepted by the line of sight O X.

A very good kind of level is made on a portable plan, by several mechanics in this branch. It consists of a small tube of glass let into a plate with which it is exactly parallel. This is the surface, shewing the bubble in the tube, as before described: the under part of the box, which may be about eight inches long, two broad, and two deep, has a spring and screw that cause the box to change its direction from either above or below the horizon, to an exact rectilinear level, as indicated by the air left in the glass tube. At the centre of the bottom of the box, is a brass stud, serving to fix into a hole made in the top of a walking stick, &c. This kind of level, in the hands of a skilful surveyor, may be used to great advantage where very great precision is not required; but as the sight is taken only from the upper edges of the box's ends, it does not admit of that great nicety which is indispensable in many operations, and where the smallest deviation from a true level might occasion immense expence and inconvenience.

The level represented in Plate Level, was made by the justly celebrated Jesse Ramsden, F. R. S, and considered by him as the most complete. It stands on three legs, which fold up into the size and appearance of a moderately thick round staff, three sliding rings, or leather bands, suffice to keep them compact and firm. The upper parts of the legs fit into a brass plate, as in theodolites, on the surface of which is a strong male screw, serving to fasten the working part of the instrument at pleasure, to its centre. The female screw is cut withinside a projection *b b* of a brass plate *a a*: this projection has a hole through its top, and contains a brass ball *d*, screwed into another similar plate *e e*; by which means the two plates are connected together, and the upper one can be turned about in any direction, while the lower one remains fixed. Four screws *s* passing through the lower plate, being worked in until they touch the bottom of the upper plate, serve either to fix the latter firmly; or, by unthreading one or two, and working in the opposite ones, to change the inclination of the upper plate, and to bring it to an exact level. These are called the parallel plates, though they often stand at an angle, the one with the other, when the direction of the upper one requires changing as above shown.

The ball *d* is perforated with a conical hole, to receive an axis *l*, that is screwed to the bottom of the compass box, *f*, on which are two square brass arms F C, projecting from it diametrically opposite to each other. H is a small brass angle, or

frame, called a Y, screwed to the end of the arm C: it supports in its forked termination one end of the telescope K, of which the other end rests in a Y, (lettered N), similar to H, but which can be raised or lowered, by means of a screw having a milled head; as seen at *y*. The spirit level L is fixed to the telescope by two screws at its ends, whereby it can be brought into exact adjustment with the culmination of the telescope.

The level, which is the essential part of the instrument, has been already described; but it is proper to add, that the ends of the tube containing the alcohol, when made of glass, should be hermetically sealed at its ends, which should then be cased in brass. Mr. Ramsden preferred a very slight convexity in the tube; considering it best adapted for shewing the most trifling deviation from a perfect level, and causing the bubble to become more accurately central. With respect to the telescope, it is similar to those generally fitted to theodolites, &c. and has been described in the preceding part of this article. It is laid on in the two Y pieces, and kept in by two curved pieces of brass. In figure *h* is the achromatic object glass, fixed within the end of a tube, sliding within the external cylinder of the telescope, and moved very gradually by a rack and pinion on the mill headed nut *i*: the distance of the glass *h* from the eye-piece, is thereby adjusted to a suitable focus.

The eye-piece K contains two lenses, sliding in a tube fixed to the telescope, for adjusting them to a distinct vision of the cross wires, or hairs, which are held in a proper state of tension in the frame *t*, and regulated to the axis, or line of sight, by four minute screws passing through the outside of the telescope.

We have before shown how the four screws act upon the two parallel plates, *a a* and *e e*, while the axis *b* can be set very nearly perpendicular; then by the screw *y* the telescope can be set very nearly level. To turn the telescope about horizontally upon its axis *l*, a screw *m*, works in a fixed collar *v*; its nut *p*, is fastened upon an arm which projects from a clamp *g*, embracing a collar upon the axis *l*, and is tightened by a screw *r*; which being unscrewed the clamp springs open, and the telescope, together with the level, moves round with freedom upon the axis *l*, according to the pleasure of the operator. When the screw *r* is tightened, the clamp holds the telescope fast, but admits of a slight movement, either way, when acted upon by the mill-headed screw *m*.

Our readers will readily perceive the simplicity of this level, beyond any others in use; and will lament the demise of a gentleman who, to profound theory, added the most ingenious and skilful practice.

Where a very long, and continued range of brickwork is to be raised, it is often advisable to use a water level, made by laying a ridge of mortar along the centre of the wall, and opening a very narrow channel throughout its centre longitudinally; so as to form a kind of trough, let the ends be stopped, and the trough be filled with water, as far as it will flow. The surface of the water will give a true horizontal level; which if continued for miles would conform exactly to the curvature of our globe. To continue the level along the rest of the trough, stop it at the place where the water reached, and raising the adjacent part with more mortar, let the trough of the superior level be filled, and thus in succession. The difference between the end of one trough, and the beginning of another will shew the respective levels; from which parallels may be set off at any height above by plumb lines of equal length. This mode is often practised in large works, such as fortifications, and when strata of masonry are to be regularly disposed; also to prevent those irregular breaks, and partial connections, that are almost inevitable where small sallows, or triangular levels, with plumb weights are in use.

When no instrument can be obtained, and where it is not easy to draw an exact level by the foregoing means, take the hose of an engine, and having fixed one end at the spot whose level is to be sought, (on any opposite bank for instance,) carry the other end to the place where the corresponding height is to be established. Fill the hose with water until it ceases to require raising at the further end. When both ends show full to the brim, and that the water is retained at both, then they are on the same level: for it is a maxim in HYDROSTATICS (which see), that water, or indeed, any fluid heavier than atmospheric air, will, when at liberty, always find its own level.

Where a succession of contiguous levels are wanted, it will often be found convenient to use a small leaden pipe, of about half an inch bore, which should be applied as above described; or even a common

gutter, made of two pieces of planks, like those under the eaves of houses, may be made to answer the purpose; by supporting either end, until the water may come to a level in every part.

Where works of moderate extent are carried on, and where the perfect level of each stratum of materials is not an object of importance the common bricklayer's level, made in the form of an inverted T, thus ⊥, having a plumb suspended from the top, and received in an opening at the junction of the perpendicular with the horizontal piece, will answer well enough. The principle on which this acts, is, that as all weights have a tendency to gravitate towards the centre of the earth, so as the plumb line, is a true perpendicular, any line cutting that at right angles must be a horizontal line at the point of intersection.

LEVEL, *artillery-foot*, is in form of a square, having its two legs or branches of an equal length, at a juncture whereof is a little hole, whence hangs a thread and plummet, playing on a perpendicular line in the middle of a quadrant. It is divided into twice forty-five degrees from the middle.

This instrument may be used on other occasions, by placing the ends of its two branches on a plane; for when the thread plays perpendicularly over the middle division of the quadrant, that plane is assuredly level. To use it in gunnery, place the two ends on the piece of artillery, which you may raise to any proposed height, by means of the plummet, whose thread will give the degree above the level.

LEVEL, *carpenter's and paviour's*, consists of a long ruler, in the middle whereof is fitted, at right angles, another somewhat bigger, at the top of which is fastened a line, which, when it hangs over a fiducial line at right angles with the base, shows that the said base is horizontal. Sometimes this level is all of one board.

LEVEL, *gunner's*, for levelling cannons and mortars, consists of a triangular brass plate, about four inches high, at the bottom of which is a portion of a circle, divided into forty-five degrees, which number is sufficient for the highest elevation of cannons and mortars, and for giving shot the greatest range: on the centre of this segment of a circle is screwed a piece of brass, by means of which it may be fixed or screwed at pleasure; the end of this piece of brass is made so as to serve for a plummet and index, in order to show the different degrees of elevation of pieces of artillery. This instrument has also a brass foot, to set upon cannons or mortars, so as when those pieces are horizontal, the instrument will be perpendicular. The foot of this instrument is to be placed on the piece to be elevated, in such a manner as that the point of the plummet may fall on the proper degree: this is what they call levelling the piece.

LEVEL, *mason's*, is composed of three rules, so joined as to form an isosceles-triangle, somewhat like a Roman A, at the vertex whereof is fastened a thread, from which hangs a plummet, that passes over a fiducial line, marked in the middle of the base, when the thing, to which the level is applied, is horizontal; but declines from the mark, when the thing is lower on one side than on the other.

LEVEL, *plumb* or *pendulum*, that which shews the horizontal line by means of another line perpendicular to that described by a plummet or pendulum. This instrument consists of two legs or branches, joined together at right angles, whereof that which carries the thread and plummet is about a foot and a half long; the thread is hung towards the top of the branch. The middle of the branch where the thread passes is hollow, so that it may hang free every where: but towards the bottom, where there is a little blade of silver, whereon is drawn a line perpendicular to the telescope, the said cavity is covered by two pieces of brass, making as it were a kind of case, lest the wind should agitate the thread; for which reason the silver blade is covered with a glass to the end, that it may be seen when the thread and plummet play upon the perpendicular. The telescope is fastened to the other branch of the instrument, and is about two feet long; having an hair placed horizontally across the focus of the object-glass, which determines the point of the level. The telescope must be fitted at right angles to the perpendicular. It has a ball and socket, by which it is fastened to the foot.

LEVELLING. See LEVEL.

LEVELLING *staves*, instruments used in levelling, serving to carry the marks to be observed, and at the same time to measure the heights of those marks from the ground. They usually consist each of two long wooden rulers, made to slide over one another, and divide into feet, inches, &c.

LEVER, in mechanics, an inflexible right

line, rod, or beam, supported in a single point on a fulcrum or prop, and used for the raising of weights; being either void of weight itself, or at least having such a weight as may be commodiously counterbalanced.

The lever is the first of those called mechanical powers, or simple machines, as being of all others the most simple; and is chiefly applied for raising weights to small heights. See MECHANICS.

LEVISANUS, in botany, so called from the Rev. Mr. Lewis, a genus of the Pentandria Monogynia class and order. Essential character: flowers aggregate; calyx one-leafed, superior, five-cleft; corolla five petalled, superior; filaments inserted into the base of the perianth; styles two, conjoined; berry two celled; seeds five or six, compressed. There are five species, which are all shrubs, and natives of the Cape of Good Hope.

LEYSERA, in botany, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx scariose; down chaffy; in the disk feathery also; receptacle subpaleaceous. There are three species.

LEY, or *lees*, a term usually applied to any alkaline solution made by levigating any ashes that contain an alkali. Soap-lees is an alkali used by soap-boilers, or potash or soda in solution, and made caustic by lime. Lees of wine are the refuse, or sediment, that deposits from wine by standing quiet.

LEYDEN *phial*, in electricity, is a glass phial or jar, coated both within and without with tin foil, or other conducting substance, that it may be charged, and employed in a variety of experiments. Flat glass, or glass of any shape, may be used in the same way.

LIATRIS, in botany, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ Capitatæ. Cinarocephalæ, Jussieu. Essential character: calyx oblong, imbricate, awnless, coloured; down feathered, coloured; receptacle naked, hollow, dotted. There are eight species.

LIBELLULA, in natural history, *dragon-fly*, a genus of insects of the order Neuroptera. Mouth armed with jaws, more than two in number; lip trifid; antennæ very thin, filiform, and shorter than the thorax; wings expanded; tail of the male insect furnished with a forked process. There are about sixty species, divided into two families. A. wings expanded when at rest. B. wings erect when at rest; eyes distinct; outer divisions of the lip bifid. The whole tribe of the libellula are remarkable for being ravenous: they are usually to be seen hovering over stagnant waters, and may, in the middle of the day, be observed flying with great rapidity in pursuit of the smaller insects. These brilliant and beautiful animals were once, and for a considerable time, inhabitants of the water: in that state, as larva, they are six-footed, active, and furnished with an articulate forcipated mouth. They prey upon aquatic insects, and the larva of others: the pupa resembles the larva, but has the rudiments of wings. The most remarkable of the English species is the L. varia, or great variegated libellula, which makes its appearance towards the decline of summer, and is an animal of singular beauty. Its length is about three inches; and the wings, when expanded, measure nearly four inches from tip to tip. The female libellula drops her eggs in the water, which, on account of their specific gravity, sink to the bottom: after a certain period they are hatched into larvæ, having a singular and disagreeable aspect: they cast their skins several times before they arrive at their full size, and are of a dusky brown colour: the rudiments of the future wings appear on the back of such as are advanced to the pupa state in the form of oblong scales, and the head is armed with a singular organ for seizing its prey. They continue in the larva and pupa state two years; when having attained to their full size, they prepare for their ultimate change, and creeping up the stem of some water plant, and grasping it with their feet, they make an effort, by which the skin of the back and head is forced open, and the enclosed libellula gradually emerges. This process takes place in a morning, and during a bright sunshine. The remainder of the animal's life is short, the frosts of autumn destroying them all. "It is impossible," says Dr. Shaw, "not to be struck with admiration on contemplating the changes of the libellula, which, while an inhabitant of the water, would perish by any long exposure to the air, while the complete animal, once escaped from the pupa, would as effectually be destroyed by submersion under water, of which not an hour before it was the legitimate inhabitant." In this, and other species of the libellula tribe, the structure of the eye is deserving of notice.

A common magnifier, of an inch focus, shows that the cornea is marked by a prodigious number of minute decussating lines, giving a kind of granular appearance to the whole convexity; but with a microscope it exhibits a continued surface of convex hexagons. According to Lewenhoek there are 12,544 lenses in each eye of this animal. See Shaw's Zoology, vol. vi.

LIBELLUS *famosus*. A contumely or reproach, published to the defamation of the government, of a magistrate, or of a private person. It is also defined to be a malicious defamation, expressed either in printing or writing, or by signs, pictures, &c. tending either to blacken the memory of one who is dead, or the reputation of one who is alive, and thereby exposing him to public hatred, contempt, and ridicule.

Libels, says Blackstone, taken in their largest and most extensive sense, signify any writings, pictures, or the like, of an immoral or illegal tendency. This species of defamation is usually termed written scandal, and thereby receives an aggravation, in that it is presumed to have been entered upon with coolness and deliberation; and to continue longer, and propagate wider and further than any other scandal.

The important distinction between libels and words spoken, was fully established in the case of Villers v. Mousley, (2 Wils. 403.) viz. that whatever renders a man ridiculous, or lowers him in the esteem and opinion of the world, amounts to a libel; though the same expressions, if spoken, would not have been defamation: as, to call a person, in writing, an itchy old toad, was held in that case to be a libel; although, as words spoken, they would not have been actionable. And on this ground, a young lady of quality, in the year 1793, recovered 4,000*l.* damages for reflections upon her chastity, published in a newspaper, although she could have brought no action for the grossest verbal aspersions that could have been uttered against her honour. An action for a libel also differs from an action for words in this particular; that the former may be brought at any time within six years, and any damages will entitle the plaintiff to full costs. To print of any person that he is a swindler, is a libel, and actionable.

All libels are made against private men, or magistrates, and public persons; and those against magistrates deserve the greatest punishment: if a libel be made against a private man, it may excite the person libelled, or his friends, to revenge and to break the peace; and if against a magistrate, it is not only a breach of the peace, but a scandal to government, and stirs up sedition.

Where a writing inveighs against mankind in general, or against a particular order of men, this is no libel; it must descend to particulars and individuals, to make it a libel. But a general reflection on the government is a libel, though no particular person is reflected on: and the writing against a known law is held to be criminal.

Though a private person or magistrate be dead at the time of making the libel, yet it is punishable, as it tends to a breach of the peace. But an indictment for publishing libellous matter reflecting on the memory of a dead person, not alledging that it was done with a design to bring contempt on the family of the deceased, and to stir up the hatred of the King's subjects against them, and to excite his relations to a breach of the peace, cannot be supported; and judgment was in this case accordingly arrested.

Scandalous matter, in legal proceedings, by bill, petition, &c. in a court of justice, amounts not to a libel, if the court hath jurisdiction of the cause. But he who delivers a paper full of reflections on any person, in nature of a petition to a committee, to any other persons except the members of parliament who have to do with it, may be punished as the publisher of a libel. And by the better opinion, a person cannot justify the printing any papers which import a crime in another, to instruct counsel, &c. but it will be a libel. 2. The communication of a libel to any one person, is a publication in the eye of the law; therefore the sending an abusive private letter to a man, is as much a libel as if it were openly printed; for it equally tends to a breach of the peace.

In the making of libels, if one man dictates, and another writes a libel, both are guilty; for the writing after another shows his approbation of what is contained in the libel; and the first reducing a libel into writing may be said to be the making it, but not the composing. If one repeats, another writes, and a third approves what is written, they are all makers of the libel; because all persons who concur to an unlawful act are guilty.

If one writes a copy of a libel and does not deliver it to others, the writing is no publication: but it has been adjudged that the copying of a libel, without authority, is writing a libel, and he that thus writes it is

a contriver; and that he who hath a written copy of a known libel, if it is found upon him, this shall be evidence of the publication; but if such libel be not publicly known, then the mere having a copy is not a publication.

When any man finds a libel, if it be against a private person, he ought to burn it, or deliver it to a magistrate; and where it concerns a magistrate, he should deliver it presently to a magistrate.

The sale of the libel by a servant in a shop, is prima facie evidence of publication, in a prosecution against the master; and is sufficient for conviction, unless contradicted by contrary evidence, shewing that he was not privy, nor in any way assenting to it.

It is immaterial, on a criminal prosecution with respect to the essence of a libel, whether the matter of it be true or false; because it equally tends to a breach of the peace; and the provocation, not the falsity, is the thing to be punished criminally; though, doubtless, the falsehood of it may aggravate its guilt and enhance its punishment. In a civil action, a libel must appear to be false as well as scandalous: for if the charge be true the plaintiff has received no private injury, and has no ground to demand for a compensation himself, whatever offence it may be against the public peace; and, therefore, upon a civil action, the truth of the accusation may be pleaded in bar of the suit. But in a criminal prosecution, the tendency which all libels have to create animosities, and to disturb the public peace, is the whole that the law considers. And, therefore, in such prosecutions, the only points to be enquired into are, first, the making or publishing of a book or writing; and secondly, whether the matter be criminal; and if both these points are against the defendant, the offence against the public is complete.

It is not competent to a defendant charged with having published a libel, to prove that a paper, similar to that for the publication of which he is prosecuted, was published on a former occasion by other persons who have never been prosecuted for it.

The punishment of libellers for either making, repeating, printing, or publishing the libel is fine, and such corporal punishment (as imprisonment, pillory, &c.) as the court in its discretion shall inflict; regarding the quantity of the offence, and the quality of the offender. Also if booksellers, &c. publish or sell libels, though they know not the contents of them, they are punishable.

It has been held that writing a seditious libel is not an actual breach of the peace: and that a member of parliament writing such a libel is entitled to his privilege from being arrested for the same.

In informations, the libel must be set out correctly, according to the words or the material sense.

It has been frequently determined, that in the trial of an indictment for a libel, the only questions for the consideration of the jury are the fact of publishing, and the truth of the inuendoes; that is, the truth of the meaning, and sense of the passages of the libel, as stated and averred in the record; whether the matter be or be not a libel, is a question of law for the consideration of the court. But the statute 32 Geo. III. c. 60, after reciting that "doubts had arisen whether on the trial of an indictment or information for the making or publishing any libel, where an issue or issues are joined between the King and the defendant, on the plea of not guilty pleaded, it be competent to the jury, impannelled to try the same, to give their verdict upon the whole matter in issue;" enacts, that "on every such trial, the jury, sworn to try the issue, may give a general verdict of guilty or not guilty, upon the whole matter put in issue, upon such indictment or information; and shall not be required or directed by the court or judge, before whom the indictment, &c. shall be tried, to find the defendant guilty, merely on the proof of the publication by such defendant, of the paper charged to be a libel, and of the sense ascribed to the same in such indictment." But it is provided by the said statute, that the court or judge shall, according to their discretion, give their opinion and directions to the jury on the matter in issue, as in other criminal cases, that the jury may also find a special verdict; and that, in case the jury shall find the defendant guilty, he may move in arrest of judgment, as by law he might have done before the passing of the act.

It has, in the case of the King, v. Lord George Gordon; and the King, v. Peltier, been held that a writing tending to defame the Sovereign of a foreign country, is a libel punishable in England. The law was not questioned in the first case; in the second the punishment was not enforced. We think there are many serious arguments against the doctrine.

In the case of Gilbert Wakefield, and of Hart and White, recently, although the offences were committed, and the trials had in Westminster and London, the defendants were committed to Dorchester and Gloucester gaols, to render their confinement the more irksome and severe.

We have thus briefly endeavoured to select the principal authorities under the law of England, with respect to libels, and we are free to confess that unless juries boldly assert the right of judging according to the general intention and honest view of the writer, rather than upon casual expressions, and the subtle inuendoes of an information, there will be found little actual liberty of the press, excepting what is allowed by the lenity of an attorney general.

For the law is strictly, that any thing which affects the character of an individual, or reflects on the government, is a libel; and with such a restraint we hold the right of free discussion upon a frail tenure. The absolute freedom of the press can, we think, never be fully obtained while truth continues to be a libel; and it is remarkable, that in former times, libels were charged as false, scandalous, and malicious writings; in the time of Lord Coke the doctrine was laid down that the falsehood of a libel was immaterial; and very recently, the word "false," has been omitted in the informations filed by the present Attorney General Sir Vicary Gibbs.

We admit that the point how far the press shall be uncontrolled is a nice question in politics, but it should be remembered that the press, that is the right of public complaint, and of exposing public delinquents to public odium, is the peoples' cheapest and best defence, and the oppressors' greatest awe. Were that right uncontrolled, no wicked government could last long; and as the press is open to all, perhaps no just and good government could long continue to be misrepresented before an enlightened and just thinking people. In England, it must be acknowledged that the practical liberty of the press has been greater than in any country in the world, but we attribute this more to the character of the government and the people, than to the law, which if rigidly exercised would be severe. We have, it is true, not had very frequently informations for libels at the suit of government, but we have never known them fail to convict, except in the case of Mr. Reeves, for a libel on the House of Commons, which was prosecuted by the popular party.

We shall observe, that the law of libels is plainly derived to us from the imperial constitutions of Rome under the Constantines, not from the laws of republican Rome, and that it came recommended to us from the Star Chamber by Lord Coke. We have not here sufficient space to investigate, as a political question, what ought to be the law of libels; and we must acknowledge, that many objections may occur to admitting truth to be a justification of a writing when it is aimed at government, and there is great difficulty in verifying charges of misconduct, even when they are confined to particular instances. It is only by long reflection, and an ardent desire for the utmost liberty that is consistent with good government, that we are led to wish that the press should be uncontrolled.

Libel, in the spiritual court, the original declaration of any action in the civil law. See statute 2 Edward VI. c. 13.

The libel used in ecclesiastical proceedings consists of three parts: 1. The major proposition, which shows a just cause of the petition. 2. The narration, or minor proposition. 3. The conclusion, or conclusive petition, which conjoins both propositions, &c.

LIBERTY, in its most general signification, is said to be a power to do as one thinks fit; unless restrained by the law of the land: and it is well observed, that human nature is ever an advocate for this liberty; it being the gift of God to man in his creation. It is upon that account the laws of England in all cases favour liberty. According to Montesquieu, liberty consists principally in not being compelled to do any thing which the law does not require; because we are governed by civil laws, and therefore we are free, living under those laws.

The absolute rights of man, considered as a free agent, endowed with discernment to know good from evil, and with power of choosing those measures which appear to him to be most desirable, are usually summed up in one general appellation, and denominated the natural liberty of mankind. This natural liberty consists properly in a power of acting as one thinks fit, without any restraint or controul, unless by the law of nature; being a right inherent in us by birth, and one of the gifts of God to man at his creation, when he endowed him with the faculty of free will.

But every man, when he enters into society, gives up a part of his natural liberty, as the price of so valuable a purchase; and in consideration of receiving the advantages of mutual commerce, obliges himself to conform to those laws which the community has thought proper to establish. This species of legal obedience is infinitely more desirable than that wild and savage liberty, which is sacrificed to obtain it. For no man, who considers a moment, would wish to retain the absolute and uncontrouled power of doing whatever he pleases; the consequence of which is, that every other man would also have the same power; and then there would be no security to individuals in any of the enjoyments of life.

Political or civil liberty, therefore, which is that of a member of society, is no other than natural liberty, so far restrained by human laws, and no further, as is necessary and expedient for the general advantage of the public.

Hence we may collect that the law, which restrains a man from doing mischief to his fellow-citizens, though it diminishes the natural, increases the civil liberty of mankind: but that every wanton and causeless restraint of the will of the subject, whether practised by a monarch, by nobility, or a popular assembly, is a degree of tyranny; nay, that even laws themselves, whether made with or without our consent, if they regulate and constrain our conduct in matters of mere indifference without any good end in view, are regulations destructive of liberty; whereas, if any public advantage can arise from observing such precepts, the controul of our private inclinations, in one or two particular points, will conduce to preserve our general freedom in others of more importance, by supporting that state of society which alone can secure our independence. So that laws, when prudently framed, are by no means subversive, but rather introductive of liberty; for where there is no law, there is no freedom.

But then, on the other hand, that constitution or form of government, is alone calculated to maintain civil liberty, which leaves the subject entire master of his own conduct, except in those points wherein the public good requires some direction or restraint.

The above definition of the learned commentator is admitted by his last editor to be clear, distinct, and rational, as far as relates to civil liberty; in the definition of which, however, he adds, it ought to be understood, or rather expressed, that the restraints introduced by the law should be equal to all; in as much so as the nature of things will admit.

Political liberty is distinguished by Mr. Christian from civil liberty, and he defines it to be the security with which from the constitution, form, and nature of the established government, the subjects enjoy civil liberty. No ideas, continues he, are more distinct than those of civil and political liberty; yet they are generally confounded; and the latter cannot yet claim an appropriate name. The learned judge (Blackstone) uses political and civil liberty indiscriminately; but it would perhaps be convenient uniformly to use those terms in the respective senses here suggested, or to have some fixed specific denominations for ideas which, in their natures, are so widely different. The last species of liberty has most engaged the attention of mankind, and particularly of the people of England.

The people of England have a firm reliance that this civil liberty is secured to them under the constitution of the government.

First. By the great charter of liberties, which was obtained, sword in hand, from King John; and afterwards with some alterations, confirmed in parliament by King Henry III. his son; which charter contained very few new grants; but as Sir Edward Coke observes, was for the most part declaratory of the principal grounds of the fundamental laws of England. Afterwards by the statute called *Confirmatio Cartarum*, 25 Edward I, whereby the great charter is directed to be allowed as the common law: all judgments contrary to it are declared void; copies of it are ordered to be sent to all the cathedral churches, and read twice a year to the people; and sentence of excommunication is directed to be as constantly denounced against all those who by word, deed, or counsel, act contrary thereto, or in any degree infringe it. Next, by a multitude of subsequent corroborating statutes from Edward I. to Henry IV.; of which the following are the most forcible.

Statute 25 Edward III. statute 5, c. 4. None shall be taken by petition or suggestion made to the King or his council, unless it be by indictment of lawful people of the

neighbourhood, or by process made by writ original at the common law. And none shall be put out of his franchises or freehold, unless he be duly brought to answer, and fore-judged by course of law; and if any thing be done to the contrary, it shall be redressed and holden for none.

Statute 42 Edward III. c. 3. No man shall be put to answer without presentment before justices, or matter of record of due process, or writ original, according to the ancient law of the land. And if any thing be done to the contrary, it shall be void in law, and held for error. After a long interval these liberties were still further confirmed by the petition of right; which was a parliamentary declaration of the liberties of the people, assented to by King Charles I. in the beginning of his reign. This was closely followed by the still more ample concessions made by that unhappy Prince to his parliament; (particularly the dissolution of the Star Chamber, by statute 16 Charles I. c. 10); before the fatal rupture between them; and by the many salutary laws, particularly the Habeas Corpus Act, passed under King Charles II.

To these succeeded the Bill of Rights, or declaration delivered by the Lords and Commons to the Prince and Princess of Orange, February 13, 1688; and afterwards enacted in parliament, when they became King and Queen; which, as peculiarly interesting, is here inserted at length.

Statute 1 William and Mary, statute 2, c. 2, § 1. Whereas the Lords Spiritual and Temporal, and Commons, assembled at Westminster, representing all the estates of the people of this realm, did upon the 13th of February 1688, present unto their Majesties, then Prince and Princess of Orange, a declaration containing that, the said Lords Spiritual and Temporal, and Commons, being assembled in a full and free representative of this nation, for the vindicating their ancient rights and liberties; declare, that the pretended power of suspending of laws, or the execution of laws, by legal authority, without consent of parliament, is illegal; that the pretended power of dispensing with laws, or the execution of laws, by regal authority, as it hath been assumed and exercised of late, is illegal; that the commission for erecting the late court of commissioners for ecclesiastical causes, and all other commissions and courts of like nature, are illegal and pernicious.

That levying money for, or to the use of the crown, by pretence of prerogative, without grant of parliament, for longer time, or in other manner than the same is or shall be granted, is illegal; that it is the right of the subjects to petition the King, and all commitments and prosecutions for such petitioning, are illegal; that the raising or keeping a standing army within the kingdom in time of peace, unless it be with consent of parliament, is against law; that the subjects which are protestants may have arms for their defence, suitable to their conditions, and as allowed by law; that election of members of parliament ought to be free; that the freedom of speech, and debates or proceedings in parliament ought not to be impeached or questioned in any court or place out of parliament; that excessive bail ought not to be required, nor excessive fines imposed, nor cruel and unusual punishments inflicted; that jurors ought to be duly impannelled and returned, and jurors which pass upon men in trials for high treason, ought to be freeholders; that all grants and promises of fines and forfeitures of particular persons before conviction, are illegal and void; and for redress of all grievances, and for the amending, strengthening, and preserving of the laws, parliaments ought to be held frequently; and they do claim, demand, and insist upon all and singular the premises, as their undoubted rights and liberties; and that no declarations, judgments, doings, or proceedings, to the prejudice of the people in any of the said premises, ought in anywise to be drawn hereafter into consequence or example; Sect. 6. All and singular the rights and liberties asserted and claimed in the said declaration are the true, ancient, and indubitable rights and liberties of the people of this kingdom, and so shall be esteemed, allowed, adjudged, and taken to be; and all the particulars aforesaid shall be firmly holden as they are expressed in the said declaration; and all officers shall serve their majesties according to the same in all times to come. Sect. 12. No dispensation by *non obstante* of any statute shall be allowed, except a dispensation be allowed of in such statute; and except in such cases as shall be especially provided for during session of parliament. Sect. 13. No charter granted before the 23d of October, 1689, shall be invalidated by this act, but shall remain of the same force as if this act had never been made. Lastly, these liberties were again asserted at the commencement of the present century, in

the Act of Settlement, statute 12 and 13 William III. c. 2, whereby the crown was limited to his present Majesty's illustrious house; and some new provisions were added at the same fortunate æra, for better securing our religion, laws, and liberties, which the statute declares to be "the birthright of the people of England;" according to the ancient doctrine of the common law.

Thus much for the declaration of our rights and liberties. The rights themselves thus defined by these several statutes, consist in a number of private immunities, which will appear, from what has been premised, to be indeed no other than, either that residuum of natural liberty, which is not required by the laws of society to be sacrificed to public convenience; or else those civil privileges which society hath engaged to provide in lieu of the natural liberties so given up by individuals. These, therefore, were formerly, either by inheritance or purchase, the rights of all mankind; but in most other countries of the world, being now more or less debased or destroyed, they at present may be said to remain, in a peculiar and emphatical manner, the rights of the people of England.

These rights may be reduced to three principal or primary articles:

The right of personal security. The right of personal liberty. The right of private property.

The right of personal security consists in a person's legal and uninterrupted enjoyment of his life, his limbs, his body, his health, and his reputation. The enjoyment of this right is secured to every subject by the various laws made for the punishment of those injuries, by which it is any way violated; for a particular detail of which, see ASSAULT, HOMICIDE, MAIHEM, LIBEL, NUISANCE, &c.

The words of the Great Charter, c. 29, are, "Nullus liber homo capiatur, imprisonetur, vel aliquo modo destruatur, nisi per legale judicium parium suorum aut per legem terræ." No freeman shall be taken, imprisoned, or any way destroyed, unless by the lawful judgment of his peers, or by the law of the land; which words, "aliquo modo destruatur," according to Coke, include a prohibition, not only of killing or maiming, but also of torturing, (to which our laws are strangers), and of every oppression by colour of an illegal authority. And it is enacted by stat. 5 Edward III. c. 9, that no man shall be attached by any accusation, nor forejudged of life or limb, nor shall his lands or goods be seized into the King's hands contrary to the Great Charter, and the law of the land. And again, by statute 28 Edward III. c. 3, that no man shall be put to death without being brought to answer by due process of law.

The right of personal liberty consists in the power of loco-motion, of changing situation, or moving one's person to whatsoever place one's own inclination may direct, without imprisonment or restraint, unless by due course of law. This right there is at present no occasion to enlarge upon. For the provisions made by the laws of England to secure it. See HABEAS *corpus*, FALSE *imprisonment*, BAIL, ARREST, &c.

The absolute right of property, inherent in every Englishman, consists in the free use, enjoyment, and disposal of all his acquisitions, without any controul or diminution, save only by the laws of the land.

Another effect of this right of private property is, that no subject of England can be constrained to pay any aids or taxes, even for the defence of the realm, or the support of the government, but such as are imposed by his own consent, or that of his representatives in parliament. By statute 25 Edward I. c. 5, 6, it is provided, that the King shall not take any aids or tasks, but by the common assent of the realm. And what that common assent is, is more fully explained by statute 34 Edward I. statute 4, c. 1; which enacts, that no talliage or aid shall be taken, without the assent of the Archbishops, Bishops, Earls, Barons, Knights, Burgesses, and other freemen of the land: and again, by statute 14 Edw. III. statute 2. c. 1. the Prelates, Earls, Barons, and Commons, Citizens, Burgesses, and Merchants, shall not be charged to make any aid, if it be not by the common assent of the great men and commons in parliament. And as this fundamental law had been shamefully evaded, under many preceding princes, by compulsive loans and benevolences, extorted without a real and voluntary consent, it was made an article in the petition of rights, 3 Charles I. that no man shall be compelled to yield any gift, loan, or benevolence, tax, or such like charge, without common consent by act of parliament. And, lastly, by the Bill of Rights, statute 1 William and Mary, statute 2, c. 2, it is declared, that levying money for or to the use of the crown, by pretence of prerogative, without grant of parliament, or for longer time, or in other man-

ner than the same is or shall be granted, is illegal.

The above is a short view of the principal absolute rights which appertain to every Englishman; and the constitution has provided for the security of their actual enjoyment, by establishing certain other auxiliary, subordinate rights, which serve principally as out-works or barriers to protect and maintain those principal rights inviolate. These are,

The constitution, powers, and privileges of parliament. The limitation of the King's prerogative. The right of applying to courts of justice for redress of injuries. The right of petitioning the King or parliament. The right of having arms for defence.

This last auxiliary right of the subjects of having arms for their defence, suitable to their condition and degree, and such as are allowed by law, is declared by the Bill of Rights; and it is, indeed, a public allowance, under due restrictions of the natural right of resistance and self-preservation, when the sanctions of society and laws are found insufficient to restrain the violence of oppression.

As to the first and second of the subordinate rights above mentioned. See Parliament, King.

With respect to the third and fourth, some short information is here subjoined.

Since the law is, in England, the supreme arbiter of every man's life, liberty, and property, courts of justice must at all times be open to the subject, and the law be duly administered therein. The emphatical words of Magna Charta, c. 29, spoken in the person of the King, who, in judgment of law (says Sir Edward Coke) is ever present, and repeating them in all his courts, are these, "Nulli vendemus, nulli negabimus, aut differemus rectum vel justitiam." To none will we sell, to none will we deny, or delay, right or justice.

It is also ordained by Magna Charta, c. 29, that no freeman shall be outlawed, that is, put out of the protection and benefit of the law, but according to the laws of the land. By statutes 2 Edward III. c. 8. 11 Richard II. c. 10, it is enacted, that no commands or letters shall be sent under the Great Seal, or the Little Seal, the Signet or Privy Seal, in disturbance of the law; or to disturb or delay common right, and though such commandments should come, the judges shall not cease to do right. This is also made a part of their oath, by statute 11 Edward III. stat. 4. And by the Bill of Rights it is declared, that the pretended power of suspending or dispensing with laws, or the execution of laws, by regal authority, without consent of parliament, is illegal. Not only the substantial part, or judicial decisions of the law, but also the formal part, or method of proceeding, cannot be altered but by parliament; for, if once those outworks were demolished, there would be an inlet to all manner of innovation in the body of the law itself. The King, it is true, may erect new courts of justice; but then they must proceed according to the old established forms of the common law. For which reason it is declared in the statute, 16 Charles I. c. 10, upon the dissolution of the court of star-chamber, that neither his Majesty nor his Privy Council have any jurisdiction, power, or authority, by English bill, petition, articles, or libel, (which were the course of proceeding in the Star-chamber borrowed from the civil law), or by any other arbitrary way whatsoever, to examine or draw into question, determine or dispose of the lands or goods of any subjects of this kingdom; but that the same ought to be tried and determined in the ordinary courts of justice, and by course of law.

The right of petitioning the King, or either house of parliament, for the redress of grievances, appertains to every individual in cases of any uncommon injury, or infringement of the rights already particularized, which the ordinary course of law is too defective to reach. The restrictions, for some there are, which are laid upon this right of petitioning in England, while they promote the spirit of peace, are no check upon that of liberty; care only must be taken, lest, under the pretence of petitioning, the subject be guilty of any riot or tumult; as happened in the opening of the memorable parliament in 1640. And to prevent this, it is provided by statute, 13 Charles II. stat. 1. c. 5, that no petition to the King, or either house of parliament, for any alteration in church or state, shall be signed by above twenty persons, unless the matter thereof be approved by three justices of the peace, or the major part of the grand jury in the county; and in London by the Lord Mayor, Aldermen, and Common Council; nor shall any petition be presented by more than ten persons at a time. But under these regulations, it is declared by the Bill of Rights, that the subject hath a right to petition; and that all commitments and prosecutions for such peti-

tioning are illegal. The sanction of the grand jury may be given either at the assizes or quarter sessions; the punishment for offending against the stat. 13 Charles II. not to exceed a fine of 100*l.* and three month's imprisonment. Upon the trial of Lord George Gordon, the Court of King's Bench declared, that they were clearly of opinion, that this statute was not in any degree affected by the Bill of Rights.

In the several articles above enumerated, consist the rights, or as they are more frequently termed, the liberties, of Englishmen. Liberties more generally talked of than thoroughly understood; and yet highly necessary to be perfectly known and considered by every man of rank or property, lest his ignorance of the points whereon they are founded, should hurry him into faction and licentiousness on the one hand, or a pusillanimous indifference, and criminal submission, on the other. And all these rights and liberties it is our birthright to enjoy entire, unless where the laws of our country have laid them under necessary restraints. So that this review of our situation may fully justify the observation of a learned French author, (of former times), who has professed that the English is the only nation in the world where political or civil liberty is the direct end of its constitution.

LIBRA, the *balance*, in astronomy, one of the twelve signs of the zodiac, the sixth in order; so called because when the sun enters it, the days and nights are equal, as if weighed in a balance. See ASTRONOMY.

LIBRA, in Roman antiquity, a pound weight; also a coin, equal in value to twenty denarii.

LIBRARY, an edifice or apartment destined for holding a considerable number of books placed regularly on shelves; or, the books themselves lodged in it.

The first who erected a library at Athens was the tyrant Pisistratus, which was transported by Xerxes into Persia, and afterwards brought back by Seleucus Nicanor to Athens. Plutarch says, that under Eumenes there was a library at Pergamus that contained 200,000 books. That of Ptolemy Philadelphus, according to A. Gellius, contained 700,000, which were all burnt by Cæsar's soldiers. Constantine and his successors erected a magnificent one at Constantinople, which in the eighth century contained 300,000 volumes, and among the rest one in which the Iliad and Odyssey were written in letters of gold, on the guts of a serpent; but this library was burnt by order of Leo Isaurus. The most celebrated libraries of ancient Rome were the Ulpian and the Palatine, and in modern Rome, that of the Vatican; the foundation of the Vatican library was laid by Pope Nicholas, in the year 1450; it was afterwards destroyed in the sacking of Rome, by the constable of Bourbon, and restored by Pope Sixtus V. and has been considerably enriched with the ruins of that of Heidelberg, plundered by Count Tilly in 1682. One of the most complete libraries in Europe, is that erected by Cosmo de Medicis; though it is now exceeded by that of the French King, which was begun by Francis I. augmented by Cardinal Richelieu, and completed by M. Colbert. The Emperor's library at Vienna, according to Lambecius, consists of 80,000 volumes, and 15,940 curious medals. The Bodleian library at Oxford exceeds that of any university in Europe, and even those of any of the sovereigns of Europe, except those of the Emperors of France and Germany, which are each of them older by a hundred years. It was first opened in 1602, and has since been increased by a great number of benefactors: indeed the Medicean library, that of Bessarion at Venice, and those just mentioned, exceed it in Greek manuscripts, but it outdoes them all in oriental manuscripts; and as to printed books, the Ambrosian at Milan, and that of Wolfenbuttle, are two of the most famous, and yet both are inferior to the Bodleian. The Cotton library consists wholly of manuscripts, particularly of such as relate to the history and antiquities of England; which, as they are now bound, make about 1000 volumes.

In Edinburgh there is a good library belonging to the university, well furnished with books, which are kept in good order, and cloistered up with wire doors, that none but the keeper can open; a method much more commodious than the multitude of chains used in other libraries. There is also a noble library of books and manuscripts belonging to the gentlemen of the law.

LIBRATION, in astronomy, an apparent irregularity of the moon's motion, whereby she seems to librate about her axis, sometimes from the east to the west, and now and then from the west to the east; so that the parts in the western limb or margin of the moon sometimes recede from the centre of the disc, and sometimes move towards it, by which means they become alternately visible and invisible to the inhabitants of the earth. See MOON.

Libration *of the earth*, is sometimes used to denote the parallelism of the earth's axis, in every part of its orbit round the sun.

LICHEN, in botany, a genus of the Cryptogamia Algæ class and order. Natural order of Algæ. Generic character: male flowers; vesicles conglomerated, extremely small, crowded or scattered on the disk, margin, or tips of the fronds: female flowers on the same, or on a distinct plant; receptacle roundish, flattish, convex, concave, subrevolute affixed to the margin, often differing from the frond in colour, within containing the seeds disposed in rows. This is a very numerous genus; many of the species are of considerable use, particularly in the art of dying. L. rocella, or orchall, as an article of commerce, is of great importance, being extremely valuable for dying wool or silk any shade of purple or crimson. L. onphalodes will dye wool of a brown reddish colour, or a dull but durable crimson, paler and more lasting than that of orchall. L. islandicus is used by the Icelanders in their broth; they also dry it, and make it into bread, &c.

Lichen, in medicine, a *tetter* or *ringworm*, a cutaneous disease, defined by Dr. Willan, "an extensive eruption of papillæ affecting adults, connected with internal disorder usually terminating in scurf, recurrent, not contagious." The Doctor has mentioned five varieties.

LICULA, in botany, a genus of the Appendix Palmæ. Natural order of Palms. Essential character: flowers all hermaphrodite; calyx and corolla three-parted; nectary sertiform; drupe. There is but one species, *viz.* L. spinosa, a native of Macassar and Celebes, where the inhabitants make much use of the narrow leaves for tobacco pipes, and the broad ones for wrapping up fruit, &c.; the wood is of little use, not being durable.

LIE, in morals, denotes a criminal breach of veracity. Dr. Paley, in treating of this subject, observes, that there are falsehoods which are not lies; that is, which are not criminal: and there are lies which are not literally and directly false.

I. Cases of the first class are those: 1. Where no one is deceived; as, for instance, in parables, fables, novels, jests, tales to create mirth, or ludicrous embellishments of a story, in which the declared design of the speaker is not to inform, but to divert; compliments in the subscription of a letter; a prisoner's pleading not guilty; an advocate asserting the justice, or his belief of the justice of his client's cause. In such instance no confidence is destroyed, because none was reposed; no promise to speak the truth is violated, because none was given, or understood to be given. 2. Where the person you speak to has no right to know the truth, or more properly where little or no inconveniency results from the want of confidence in such cases; as where you tell a falsehood to a madman for his own advantage; to a robber, to conceal your property; to an assassin, to defeat or to divert him from his purpose. It is upon this principle, that, by the laws of war, it is allowed to deceive an enemy by feints, false colours, spies, false intelligence, and the like; but, by no means, in treaties, truces, signals of capitulation, or surrender: and the difference is, that the former suppose hostilities to continue, the latter are calculated to terminate or suspend them. Many people indulge in serious discourse a habit of fiction and exaggeration, in the accounts they give of themselves, of their acquaintance, or of the extraordinary things which they have seen or heard; and so long as the facts they relate are indifferent, and their narratives, though false, are inoffensive, it may seem a superstitious regard to truth to censure them merely for truth's sake. Yet the practice ought to be checked: for, in the first place, it is almost impossible to pronounce beforehand with certainty concerning any lie, that it is inoffensive, or to say what ill consequences may result from a lie apparently inoffensive: and, in the next place, the habit, when once formed, is easily extended to serve the designs of malice or interest; like all habits, it spreads indeed of itself. Pious frauds, as they are improperly enough called, pretended inspirations, forged books, counterfeit miracles, are impositions of a more serious nature. It is possible that they may sometimes, though seldom, have been set up and encouraged with a design to do good; but the good they aim at requires that the belief of them should be perpetual, which is hardly possible; and the detection of the fraud is sure to disparage the credit of all pretensions of the same nature. Christianity has suffered more injury from this cause than from all other causes put together.

II. As there may be falsehoods which are not lies, so there may be lies without literal or direct falsehood. An opening is always left for this species of prevarication, when the literal and grammatical signification of a sentence is different from the popular and customary meaning. It is the wilful deceit that makes the lie; and we wilfully deceive

when our expressions are not true in the sense in which we believe the hearer apprehends them. Besides, it is absurd to contend for any sense of words in opposition to usage; for all senses of all words are founded upon usage, and upon nothing else. Or a man may act a lie; as by pointing his finger in a wrong direction when a traveller inquires of him his road, or when a tradesman shuts up his windows to induce his creditors to believe that he is abroad; for to all moral purposes, and therefore as to veracity, speech and action are the same; speech being only a mode of action. See Paley's Moral Philosophy.

LIEUTENANT, an officer who supplies the place, and discharges the office of a superior in his absence. Of these, some are civil, as the lords-lieutenants of kingdoms, and the lords-lieutenants of counties; and others are military, as the lieutenant-general, lieutenant-general of the artillery, lieutenant-colonel, lieutenant of artillery of the Tower, lieutenants of horse, foot, ships of war, &c.

Lieutenant, *lord, of Ireland*, is properly a viceroy, and has all the state and grandeur of a king of England, except being served upon the knee. He has the power of making war and peace, of bestowing all the offices under the government, of dubbing knight, and of pardoning all crimes except high treason; he also calls and prorogues the parliament, but no bill can pass without the royal assent. He is assisted in his government by a privy-council; and, on his leaving the kingdom, he appoints the lords of the regency, who govern in his absence.

Lieutenants, *lords, of counties*, are officers, who, upon any invasion or rebellion, have power to raise the militia, and to give commissions to colonels and other officers, to arm and form them into regiments, troops, and companies. Under the lords-lieutenants, are deputy-lieutenants, who have the same power; these are chosen by the lords-lieutenants out of the principal gentlemen of each county, and presented to the King for his approbation.

Lieutenant *general*, is an officer next in rank to the general; in battle, he commands one of the wings; in a march, a detachment, or a flying-camp; also a quarter, at a siege, or one of the attacks, when it is his day of duty.

Lieutenant *of a ship of war*, the officer next in rank and power to the captain; of these there are several in a large ship, who take precedence according to the dates of their first commissions. The oldest lieutenant, during the absence of the captain, is charged with the command of the ship, as also the execution of whatever orders he may have received from the commander, relating to the King's service. The lieutenant who commands the watch at sea, keeps a list of all the officers and men thereto belonging, in order to muster them when he judges it expedient, and report to the captain the names of those who are absent from their duty. During the night-watch he occasionally visits the lower decks, or sends thither a careful officer to see that the proper centinels are at their duty, and that there is no disorder amongst the men; no tobacco smoked between decks, nor any fire or candles burning there, except the lights which are in lanterns, under the care of a proper watch, for particular purposes. He is expected to be always on deck in his watch, as well to give the necessary orders with regard to trimming the sails, and superintending the navigation, as to prevent any noise and confusion; but he is never to change the ship's course without the captain's directions, unless to avoid an immediate danger. In time of battle, the lieutenant is particularly to see that all the men are present at their quarters, where they have been previously stationed, according to the regulations made by the captain. He orders and exhorts them every where to perform their duty, and acquaints the captain at all other times of the misbehaviour of any persons in the ship, and of whatever else concerns the service or discipline.

LIFE, *duration of.* The uncertainty of the continuance of human life, has been a fruitful source of serious reflections not only to divines and moralists of all ages, but occasionally to every individual of the human race. Independent of the host of fatal diseases which are continually augmenting the list of their victims, the frequently occurring instances of persons apparently in full possession of all the requisites to the continuance of life, being unexpectedly consigned to the grave, would cause men to think life more uncertain than they generally appear to consider it, did not the experience of living from one day to another, confirmed by the whole of their past lives, impress them with the expectation of continuing so to do, while they do not feel any known impediment to it; and it is necessary to the well being of society that this idea should in general preponderate. But as the property or income from which many persons derive their subsistence depends on the continuance of their life, or that of

others, cases will frequently occur in the adjustment of pecuniary concerns, in which it is desirable to be able to form an estimate of the duration of life, and as it is evidently a subject on which certainty cannot be attained, we must be content with that species of knowledge which rests on probability. This degree of knowledge, which is the limit of our acquaintance, with many other important facts, is, in a comprehensive view of this subject, infinitely more useful and proper than more positive knowledge would be.

At whatever period the world was first inhabited, there is undoubted evidence that for at least 3000 years past the general duration of human life has been much the same as it now is; nor has any great difference been observed between the inhabitants of different climates, the negro of Africa (in some instances at least) attaining to as great age as the European. The human frame appears to adapt itself with little difficulty to the atmosphere and local peculiarities of the country in which it is born, or even into which it is afterwards removed. Thus not only the children of persons who have removed from Great Britain to different parts of the continent of North America, but also the emigrants themselves, have been found to live as long as in the former country. Men can live equally well under very different circumstances, it is sudden changes that are injurious to the human frame; and temperate climates being less liable to such changes are found to be most favourable to the duration of life. There are however in almost every country, particular districts in which the inhabitants are found to live longer than in other situations, which proceeds chiefly from a free circulation of air, uncontaminated by the noxious vapours and exhalations which destroy its purity in other parts; thus hilly districts are almost universally found to furnish more instances of long life, than low and marshy situations.

The knowledge of the duration of human life in general, and of its probable continuance at all ages, has been ascertained with sufficient correctness for all practical purposes from the observations which have been made on the bills of mortality of different places. Dr. Halley formed a table of the probabilities of life from the registers of the births and burials of the inhabitants of the city of Breslaw, the capital of the duchy of Silesia in Germany, from the year 1687 to 1691. A similar table was formed by Mr. Thomas Simpson from the London bills of mortality, from 1728 to 1737; and other tables of the same kind have been since published by M. Dupré de St. Maur, M. Kerseboom, M. de Parcieux, Dr. Price, and others, from which the following are selected.

TABLE I. Shewing the Probabilities of the Duration of Human Life at all Ages, formed from the Register of Mortality at Northampton, for 46 Years from 1735 to 1780.

Age.	Persons living.	Decrem. of Life.	Age.	Persons living.	Decrem. of Life.	Age.	Persons living.	Decrem. of Life.	Age.	Persons living.	Decrem. of Life.
0	11650	3000	25	4760	75	49	2936	79	73	992	80
1	8650	1367	26	4685	75	50	2857	81	74	912	80
2	7283	502	27	4610	75	51	2776	82	75	832	80
3	6781	335	28	4535	75	52	2694	82	76	752	77
4	6446	197	29	4460	75	53	2612	82	77	675	73
5	6249	184	30	4385	75	54	2530	82	78	602	68
6	6065	140	31	4310	75	55	2448	82	79	534	65
7	5925	110	32	4235	75	56	2366	82	80	469	63
8	5815	80	33	4160	75	57	2284	82	81	406	60
9	5735	60	34	4085	75	58	2202	82	82	346	57
10	5675	52	35	4010	75	59	2120	82	83	289	55
11	5623	50	36	3935	75	60	2038	82	84	234	48
12	5573	50	37	3860	75	61	1956	82	85	186	41
13	5523	50	38	3785	75	62	1874	81	86	145	34
14	5473	50	39	3710	75	63	1793	81	87	111	28
15	5423	50	40	3635	76	64	1712	80	88	83	21
16	5373	53	41	3559	77	65	1632	80	89	62	16
17	5320	58	42	3482	78	66	1552	80	90	46	12
18	5262	63	43	3404	78	67	1472	80	91	34	10
19	5199	67	44	3326	78	68	1392	80	92	24	8
20	5132	72	45	3248	78	69	1312	80	93	16	7
21	5060	75	46	3170	78	70	1232	80	94	9	5
22	4985	75	47	3092	78	71	1152	80	95	4	3
23	4910	75	48	3014	78	72	1072	80	96	1	1
24	4835	75									

The probability that a life of any present age shall continue a certain number of years, or shall attain to any other given age, is the fraction whose numerator is the number of the living in the table opposite to the given age, and the denominator the number opposite to the present age of the given life. Thus the probability that a life of 25 shall attain to the age of 45, or live 20 years, is $\frac{3248}{4760}$. The difference between this fraction and unity gives the probability that the event will not happen; the probability that a life of 25 will not live 20 years, is therefore $\frac{1512}{4760}$, consequently the odds of living to dying in this period are more than 2 to 1. The probability that a person of 32 years of age shall attain to 59 years, appears by the table to be $\frac{2120}{4235}$, or nearly an even chance.

In order to find the expectation of life at any age, from a table, like the above, which shows the number that die annually at all ages, divide the sum of all the living in the table, at the age whose expectation is required and at all greater ages, by the sum of all that die annually at that age and above it; or, which is the same, by the number of the living at that age; and half unity subtracted from the quotient will give the expectation required. Thus, at the age of 65, the sum of all the living at that and all greater ages, is 18,580; the number living at that age is 1,632; and the former number divided by the latter, and half unity subtracted from the quotient, gives 10.88 for the expectation of the age of 65. In this manner the following table is formed.

TABLE II.

Shewing the Expectations of Human Life at every Age, deduced from the Northampton Table of Observations.

Ages.	Expect.	Ages.	Expect.	Ages.	Expect.	Ages.	Expect.	Ages.	Expect.	Ages	Expect.
0	25.18	17	35.20	33	26.72	49	18.49	65	10.88	81	4.41
1	32.74	18	34.58	34	26.20	50	17.99	66	10.42	82	4.09
2	37.79	19	33.99	35	25.68	51	17.50	67	9.96	83	3.80
3	39.55	20	33.43	36	25.16	52	17.02	68	9.50	84	3.58
4	40.58	21	32.90	37	24.64	53	16.54	69	9.05	85	3.37
5	40.84	22	32.39	38	24.12	54	16.06	70	8.60	86	3.19
6	41.07	23	31.88	39	23.60	55	15.58	71	8.17	87	3.01
7	41.03	24	31.36	40	23.08	56	15.10	72	7.74	88	2.86
8	40.79	25	30.85	41	22.56	57	14.63	73	7.33	89	2.66
9	40.36	26	30.33	42	22.04	58	14.15	74	6.92	90	2.41
10	39.78	27	29.82	43	21.54	59	13.68	75	6.54	91	2.09
11	39.14	28	29.30	44	21.03	60	13.21	76	6.18	92	1.75
12	38.49	29	28.79	45	20.52	61	12.75	77	5.83	93	1.37
13	37.83	30	28.27	46	20.02	62	12.28	78	5.48	94	1.05
14	37.17	31	27.76	47	19.51	63	11.81	79	5.11	95	0.75
15	36.51	32	27.24	48	19.00	64	11.35	80	4.75	96	0.50
16	35.85										

These tables suggest an easy method of finding the number of inhabitants of a place from the bills of mortality; for, supposing the yearly births and deaths equal, it is only necessary to find in the way above described, the expectation of an infant just born, and this multiplied by the number of yearly births will be the number of inhabitants.

From all the observations which have been made on the bills of mortality of different places, the fact is fully ascertained that the duration of human life is greater in all its stages in country parishes and moderate sized towns, than in large and crowded cities. According to Simpson's correction of Smarts Table for London, only one in 44 of the inhabitants attain to the age of 80 years; Dr. Price gives the proportion somewhat greater, or about 1 in 40, but observes that of those who are natives of London, a much less proportion

arrive to that age. The proportion of the inhabitants of other places that live to the age of 80, has been found as follows :

At Edinburgh..........	1 in 42
Vienna..............	1 in 41
Breslaw............	1 in 41
Berlin..............	1 in 37
Norwich............	1 in 27
Northampton......	1 in 24
Pais de Vaud	1 in 21½

Among any considerable number of lives selected from the common mass, such as the nominees to a tontine, or the members of an assurance or annuity society, the duration of life will always be found greater than it is represented by tables formed from general bills of mortality. Thus, M. Kerseboom found that among the state annuitants in Holland 1 in 14 lived to upwards of 80 years of age, and the nominees to the life annuities granted by the governments of France and Great Britain have been found to live longer than the duration given by any table formed from bills of mortality. In some few country situations, where the injurious habits and artificial mode of living which prevail in large cities have made little progress, the duration of life has been found unusually great; thus at Ackworth in Yorkshire 1 in 14 died turned of 80 years of age; and according to an account of the parish of Kingham in New England, in the first volume of "Memoirs of the American Academy," the number of deaths in 54 years had been 1113, of which 1 in 13 had survived 80 years.

Life *annuities*. See Annuities. Life annuities secured by land, differ from those already described only in this, that the annuity is to be paid up to the very day of the death of the age in question, or of the person upon whose life the annuity is granted. To obtain the more exact value therefore of such an annuity, a small sum must be added to the same as computed by the rules in the article Annuities, which will be different according as the payments are yearly, half-yearly, or quarterly. Dr. Price has entered at large on the subject, and according to him the addition is,

$\frac{y}{2n}$ for annual payments.

$\frac{h}{4n}$ for half-yearly payments.

$\frac{q}{8n}$ for quarterly payments.

where n is the complement of the given age, or what it wants of 86 years; and y, h, q, are the respective values of an annuity certain of n years payable yearly, half-yearly, or quarterly. It is found as the result of many investigations, that the first of these additional quantities is about

$\frac{1}{6}$th of one year's purchase.

The second $\frac{1}{10}$th.

The third $\frac{1}{20}$th.

Life *boat*. See Boat.

LIFE *estates*, or *estates for life*, are of two kinds; either such as are created by the act of the parties, or such as are created by the operation of law, as estates by the curtesy or dower. Estates for life, created by deed or grant, are, where a lease is made of lands or tenements to a man, to hold for the term of his own life, or for that of another person, or for more lives than one; in any of which cases he is called tenant for life, only when he holds the estate by the life of another, he is usually termed tenant *pur auter vie*, for another's life. Estates for life may be created not only by the express terms before mentioned, but also by a general grant, without defining or limiting any specific estate. Where estates are granted for the lives of others, and they absent themselves seven years, and no proof is made of their being in existence; in any action commenced for the recovery of such tenements by the lessors or reversioners, they shall be accounted as dead, and the jury shall give their verdict accordingly; (19 Charles II. c. 6.) and, on application to the Chancellor, the party holding such estates may be compelled to produce the persons on whose lives such estates depend.

LIGAMENT, in anatomy, a strong compact substance, serving to join two bones together.

A ligament is more flexible than a cartilage, not easily ruptured or torn, and does not yield, or at least very little, when pulled.

LIGHT, is that principle or thing by which objects are made perceptible to our sense of seeing; or the sensation occasioned in the mind by the view of luminous objects. The nature of light has been a subject of speculation from the first dawnings of philosophy. Some of the earliest philosophers doubted whether objects became visible by means of any thing proceeding from them, or from the eye of the spectator; but this opinion was qualified by Empedocles and Plato, who maintained, that vision was occasioned by particles continually flying off from the surfaces of bodies, which met with others proceeding from the

eye; while the effect was ascribed by Pythagorus solely to the particles proceeding from the external objects, and entering the pupil of the eye. But Aristotle defines light to be the act of a transparent body, considered as such; and he observes, that light is not fire, nor yet any matter radiating from the luminous body, and transmitted through the transparent one.

The Cartesians have refined considerably on this notion; and hold that light, as it exists in the luminous body, is only a power or faculty of exciting in us a very clear and vivid sensation; or that it is an invisible fluid present at all times and in all places, but requiring to be set in motion by a body ignited or otherwise properly qualified to make objects visible to us.

Father Malbranche explains the nature of light from a supposed analogy between it and sound. Thus he supposes all the parts of a luminous body are in a rapid motion, which, by very quick pulses, is constantly compressing the subtle matter between the luminous body and the eye, and excites vibrations of pression: as these vibrations are greater, the body appears more luminous; and as they are quicker or slower, the body is of this or that colour. The Newtonians maintain, that light is not a fluid, but consists of a great number of very small particles, thrown off from the luminous body by a repulsive power, with an immense velocity, and in all directions. And these particles, it is also held, are emitted in right lines: which rectilinear motion they preserve till they are turned out of their path by some of the following causes, viz. by the attraction of some other body near which they pass, which is called inflection, or by passing obliquely through a medium of different density, which is called refraction; or by being turned aside by the opposition of some intervening body, which is called reflection; or lastly, by being totally stopped by some substance into which they penetrate, and which is called their extinction. A succession of these particles following one another, in an exact straight line, is called a ray of light; and this ray, in whatever manner its direction may be changed, whether by refraction, reflection, or inflection, always preserves a rectilinear course, till it be again changed; neither is it possible to make it move in the arch of a circle, ellipsis, or other curve. For the above properties of the rays of light, see the several words REFRACTION, REFLECTION, &c.

The velocity of the rays of light is truly astonishing, amounting to nearly two hundred thousand miles in a second of time, which is about a million times greater than the velocity of a cannon ball. And this amazing motion of light has been manifested in various ways, and first from the eclipses of Jupiter's satellites. It was first observed by Roemer, that the eclipses of those satellites happen sometimes sooner, and sometimes later, than the times given by the tables of them; and that the observation was before or after the computed time, according as the earth was nearer to, or further from Jupiter, than the mean distance. Hence Roemer and Cassini both concluded, that this circumstance depended on the distance of Jupiter from the earth; and that, to account for it, they must suppose that the light was about fourteen minutes in crossing the earth's orbit. This conclusion, however, was afterwards abandoned, and attacked by Cassini himself: but Roemer's opinion found an able advocate in Dr. Halley, who removed Cassini's difficulty, and left Roemer's conclusion in its full force.

It has since been found, by repeated experiments, that when the earth is exactly between Jupiter and the sun, his satellites are seen eclipsed eight minutes and a quarter sooner than they could be according to the tables; but when the earth is nearly in the opposite point of its orbit, these eclipses happen about eight minutes and a quarter later than the tables predict them. Hence, then, it is certain that the motion of light is not instantaneous, but that it takes up about sixteen minutes and a half of time to pass over a space equal to the diameter of the earth's orbit, which is at least one hundred and ninety millions of miles in length, or at the rate of near two hundred thousand miles per second, as above-mentioned.

Hence, therefore, light takes up about eight minutes and a quarter in passing from the sun to the earth; so that, if he should be annihilated, we should see him for eight minutes and a quarter after that event should happen; and if he were again created, we should not see him till eight minutes and a quarter afterwards. Hence also it is easy to know the time in which light travels to the earth, from the moon, or any of the other planets, or even from the fixed stars, when their distances shall be known; these distances are, however, so immensely great, that from the nearest of them, supposed to be Sirius, the dog-star, light takes up many years to travel to the earth: and

it is even suspected, that there are many stars whose light has not yet arrived at us since their creation. And this, by-the-bye, may perhaps sometimes account for the appearance of new stars in the heavens. Our excellent astronomer, Dr. Bradley, afterwards found nearly the same velocity of light as Roemer, from his accurate observations, and most ingenious theory, to account for some apparent motions in the fixed stars; for an account of which see ABERRATION *of light*. By a long series of these observations, he found the difference between the true and apparent place of several fixed stars, for different times of the year; which difference could no otherwise be accounted for, than for the progressive rays of light. From the mean quantity of this difference he ingeniously found, that the ratio of the velocity of light to the velocity of the earth in its orbit, was as 10,313 to 1, or that light moves 10,313 times faster than the earth moves in its orbit about the sun; and as this latter motion is at the rate of 18$\frac{11}{12}$ miles per second nearly, it follows that the former, or the velocity of light, is at the rate of about 195,000 miles in a second; a motion according to which it will require just 8′ 7″ to move from the sun to the earth, or about 95,000,000 of miles.

It was also inferred, from the foregoing principles, that light proceeds with the same velocity from all the stars. And hence it follows, if we suppose that all the stars are not equally distant from us, as many arguments prove, that the motion of light, all the way it passes through the immense space above our atmosphere, is equable or uniform. And since the different methods of determining the velocity of light, thus agree in the result, it is reasonable to conclude, that in the same medium, light is propagated with the same velocity after it has been reflected as before. For an account of Mr. Melville's hypothesis of the different velocities of differently coloured rays, see COLOUR.

To the doctrine concerning the materiality of light, and its amazing velocity, several objections have been made, of which the most considerable is; that as rays of light are continually passing in different directions from every visible point, they must necessarily interfere with each other in such a manner as entirely to confound all distinct perception of objects, if not quite to destroy the whole sense of seeing; not to mention the continual waste of substance, which a constant emission of particles must occasion in the luminous body, and thereby, since the creation, must have greatly diminished the matter in the sun and stars, as well as increased the bulk of the earth and planets, by the vast quantity of particles of light absorbed by them in so long a period of time. But it has been replied, that if light were not a body, but consisted in mere pression or pulsion, it could never be propagated in right lines, but would be continually inflected *ad umbram*. Thus, Sir Isaac Newton: "A pressure on a fluid medium, *i. e.* a motion propagated by such a medium, beyond any obstacle, which impedes any part of its motion, cannot be propagated in right lines, but will be always inflecting and diffusing itself every way, to the quiescent medium beyond that obstacle.

The power of gravity tends downwards; but the pressure of water arising from it tends every way with an equable force, and is propagated with equal ease and equal strength, in curves as in straight lines. Waves, on the surface of the water, gliding by the extremes of any very large obstacle, inflate and dilate themselves, still diffusing gradually into the quiescent water beyond that obstacle. The waves, pulses, or vibrations of the air, wherein sound consists, are manifestly inflected, though not so considerably as the waves of water; and sounds are propagated with equal ease through crooked tubes and through straight lines; but light was never known to move in any curve, nor to inflect itself *ad umbram*."

It must be acknowledged, however, that many philosophers, both English and foreigners, have recurred to the opinion, that light consists of vibrations propagated from the luminous body, through a subtle ethereal medium.

Dr. Franklin, in a letter dated April 23, 1752, expresses his dissatisfaction with the doctrine, that light consists of particles of matter continually driven off from the sun's surface, with so enormous a swiftness. "Must not," says he, "the smallest portion conceivable have, with such a motion, a force exceeding that of a twenty-four pounder discharged from a cannon? Must not the sun diminish exceedingly by such a waste of matter; and the planets, instead of drawing nearer to him, as some have feared, recede to greater distances, through the lessened attraction? yet these particles, with this amazing motion, will not drive before them, or remove, the least and slight-

est dust they meet with; and the sun appears to continue of his ancient dimensions, and his attendants move in their ancient orbits." He therefore conjectures, that all the phenomena of light may be more properly solved, by supposing all space filled with a subtle elastic fluid, which is not visible when at rest, but which, by its vibrations, affects the fine sense in the eye, as those of the air affect the grosser organs of the ear; and even that different degrees of the vibration of this medium may cause the appearances of different colours. Franklin's Exper. and Observ. 1769, p. 264.

The celebrated Euler has also maintained the same hypothesis, in his "Theoria Lucis et Colorum." In the summary of his arguments against the common opinion, recited in Acad. Berl. 1752, p. 271, besides the objections above-mentioned, he doubts the possibility, that particles of matter, moving with the amazing velocity of light, should penetrate transparent substances with so much ease. In whatever manner they are transmitted, those bodies must have pores, disposed in right lines, and in all possible directions, to serve as canals for the passage of the rays; but such a structure must take away all solid matter from those bodies, and all coherence among their parts, if they do contain any solid matter.

Among modern philosophers who have supported this doctrine, Dr. Young has shown much ability in his experimental and theoretical researches, in his memoirs in the "Philosophical Transactions," which have been republished in his "Lectures," and in "Nicholson's Journal."

The expansion or extension of any portion of light is inconceivable. Dr. Hook shows, that it is as unlimited as the universe, which he proves from the immense distance of many of the fixed stars, which only become visible to the eye by the best telescopes. "Nor," adds he, "are they only the great bodies of the sun or stars that are thus liable to disperse their light through the vast expanse of the universe, but the smallest spark of a lucid body must do the same, even the smallest globule struck from a steel by a flint."

The intensity of different lights, or of the same light in different circumstances, affords a curious subject of speculation. M. Bouguer, Traité de Optique, found that when one light is from sixty to eighty times less than another, its presence or absence will not be perceived by an ordinary eye; that the moon's light, when she is 19° 16′ high above the horizon, is about one-third of her light, at 66° 11′ high; and when one limb just touched the horizon, her light was but the 2,000th part of her light at 66° 11′ high; and that hence light is diminished in the proportion of three to one, by traversing 7,469 toises of dense air. He found also, that the centre of the sun's disc is considerably more luminous than the edges of it; whereas both the primary and secondary planets are more luminous at their edges than near their centres: that, further, the light of the sun is about 300,000 times greater than that of the moon; and therefore it is no wonder that philosophers have had so little success in their attempts to collect the light of the moon with burning glasses; for, should one of the largest of them even increase the light 1,000 times, it will still leave the light of the moon in the focus of the glass, 300 times less than the intensity of the common light of the sun.

Dr. Smith, in his optics, vol. i. p. 29, thought he had proved that the light of the full moon would be only the 90,900th part of the full day-light, if no rays were lost at the moon. But Mr. Robins, in his Tracts, vol. ii. p. 225, shows that this is too great by one half. And Mr. Michell, by a more easy and accurate mode of computation, found that the density of the sun's light on the surface of the moon, is but the 45,000th part of the density at the sun; and, that therefore, as the moon is nearly of the same apparent magnitude as the sun, if she reflected to us all the light received on her surface, it would be only the 45,000th part of our day-light, or that which we receive from the sun. Admitting, therefore, with M. Bouguer, that the moon's light is only the 300,000th part of the day, or sun's light; Mr. Michell concludes that the moon reflects no more than between the 6th and 7th part of what she receives.

Sir I. Newton long ago observed, that bodies and light act mutually on one another; bodies on light, in emitting, reflecting, refracting, and inflecting it; and light on bodies, by heating them, and putting their parts into a vibrating motion, in which heat principally consists. For all fixed bodies, he observes, when heated beyond a certain degree, do emit light and shine.

This action of bodies on light is found to exert itself at a sensible distance, though it always increases as the distance is diminished, as appears very sensibly in the passage

of a ray between the edges of two very thin planes, at different apertures; which is attended with this peculiar circumstance, that the attraction of one edge is increased as the other is brought nearer it.

The rays of light, in their passage out of glass into a vacuum, are not only inflected towards the glass, but if they fall too obliquely, they will revert back again to the glass, and be totally reflected. Now the cause of this reflection cannot be attributed to any resistance of the vacuum, but must be entirely owing to some force or power in the glass, which attracts or draws back the rays as they were passing into the vacuum. And this appears further from hence, that if you wet the back surface of the glass with water, oil, honey, or a solution of quicksilver, then the rays which would otherwise have been reflected, will pervade and pass through that liquor; which shows that the rays are not reflected till they come to that back surface of the glass, nor even till they begin to go out of it; for if at their going out they fall into any of the aforesaid mediums, they will not then be reflected, but will persist in their former course, the attraction of the glass being in this case counterbalanced by that of the liquor.

M. Maraldi prosecuted experiments similar to those of Sir I. Newton, on inflected light. And his observations chiefly respect the inflection of light towards other bodies, by which their shadows are partially illuminated. Acad. Paris 1723, Mem. p. 159. See also Priestley's Hist. p. 521, &c.

From the mutual attraction between the particles of light and other bodies, arise two other grand phenomena, besides the inflection of light, which are called the reflection and refraction of light. It is well known that the determination of bodies in motion, especially elastic ones, is changed by the interposition of other bodies in their way; thus also light, impinging on the surfaces of bodies, should be turned out of its course, and beaten back or reflected, so as, like other striking bodies, to make the angle of its reflection equal to the angle of incidence. This, it is found by experience, light does; and yet the cause of the effect is different from that just now assigned, for the rays of light are not reflected by striking on the very parts of the reflecting bodies, but by some power equally diffused over the whole surface of the body, by which it acts on the light, either attracting or repelling it, without contact: by which same power, in other circumstances, the rays are refracted; and by which also the rays are first emitted from the luminous body; as Newton abundantly proves by a great variety of arguments. See REFLECTION and REFRACTION.

That great author put it past doubt, that all those rays which are reflected do not really touch the body, though they approach it infinitely near; and that those which strike on the parts of solid bodies adhere to them, and are, as it were, extinguished and lost. Since the reflection of the rays is ascribed to the action of the whole surface of the body without contact: if it be asked how it happens that all the rays are not reflected from every surface, but that, while some are reflected, others pass through and are refracted? the answer given by Newton is as follows: Every ray of light, in its passage through any refracting surface, is put into a certain transient constitution or state, which in the progress of the ray returns at equal intervals, and disposes the ray at every return to be easily transmitted through the next refracting surface, and between the returns to be easily reflected by it: which alteration of reflection and transmission, it appears, is propagated from every surface, and to all distances. What kind of action or disposition this is, and whether it consists in a circulating or vibrating motion of the ray, or the medium, or something else, he does not inquire; but allows those who are fond of hypothesis to suppose that the rays of light, by impinging on any reflecting or refracting surface, excite vibrations in the reflecting or refracting medium, and by that means agitate the solid parts of the body. These vibrations, thus produced in the medium, move faster than the rays, so as to overtake them; and when any ray is in that part of the vibration which conspires with its motion, its velocity is increased, and so it easily breaks through a refracting surface; but when it is in a contrary part of the vibration, which impedes its motion, it is easily reflected; and thus every ray is successively disposed to be easily reflected or transmitted by every vibration which meets it. These returns in the disposition of any ray to be reflected, he calls fits of easy reflection; and the returns in the disposition to be transmitted, he calls fits of easy transmission; also the space between the returns, the interval of the fits. Hence then the reason why the surfaces of all thick transparent bodies reflect part of the light incident upon them, and refract the rest

is that some rays, at their incidence, are in fits of easy reflection, and others of easy transmission. For the properties of reflected light, see MIRROR, OPTICS, &c.

Again, a ray of light passing out of one medium into another of different density, and in its passage making an oblique angle with the surface that separates the mediums, will be refracted, or turned out of its direction; because the rays are more strongly attracted by a denser, than by a rarer medium. That these rays are not refracted by striking on the solid parts of bodies, but that this is effected without a real contact, and by the same force by which they are emitted and reflected, only exerting itself differently in different circumstances, is proved, in a great measure, by the same arguments by which it is demonstrated that reflection is performed without contact.

When light is refracted by a prism, or other transparent body, it is divided into rays exciting the sensation of different colours; namely, red, orange, yellow, green, blue, indigo, and violet. This is the enumeration followed by Newton and others, which supposes seven rays refrangible in the above order, the red being least refrangible and the violet most so, and that the other tints are produced by mixture. The image formed by the different rays, thus separated, forms the solar spectrum. Dr. Wollaston has shewn, by looking through the prism at a narrow line of light, that the primitive colours are only red, green, blue, and violet.

Heat and light are not present in corresponding degrees, in different parts of the solar spectrum; for, generally speaking, those rays illuminate most that have the least heating power. The rays in the centre of the spectrum have the greatest illuminating power, as may be ascertained by viewing, successively in each, a small body, such as the head of a common nail. It will be seen most distinctly in the light green, or deep yellow rays, and less plainly towards either extremity of the spectrum.

The heating power of the rays follows a different order. If the bulb of a sensible thermometer be moved, in succession, through the differently coloured rays, it will be found to indicate the greatest heat in the red rays, next in the green, and so on, in a diminishing progression, to the violet. When the thermometer is removed entirely out of the confines of the red rays, but with its ball still in the line of the spectrum, it rises even higher than in the red rays; and continues to rise till removed half an inch beyond the extremity of the red ray. The ball of the thermometer employed for this purpose should be extremely small, and should be blackened with Indian ink. An air thermometer is better adapted than a mercurial one, to exhibit the minute change of temperature that ensues. These invisible heat-making rays may be reflected by the mirror, and refracted by the lens, exactly in the same manner as the rays of light.

Beyond the confines of the spectrum on the other side, *viz.* a little beyond the violet ray, the thermometer is not affected; but in this place it is remarkable that there are also invisible rays of a different kind, which exert all the chemical effects of the rays of light, and even with greater energy. One of the chemical properties of light is, that it speedily changes from white to black the fresh precipitated muriate of silver. This effect is produced most rapidly by the direct light of the sun; and the rays, as separated by the prism, have this property in various degrees. The blue rays, for example, effect a change of the muriate of silver in fifteen seconds, which the red require twenty minutes to accomplish; and, generally speaking, the power diminishes as we recede from the violet extremity. But entirely out of the spectrum, and beyond the violet rays, the effect is still produced. Hence it appears that the solar beams consist of three distinct kinds of rays; of those that excite heat, and promote oxydation; of illuminating rays; and of de-oxydizing rays. A striking illustration of the different power of these various rays, is furnished by their effect on phosphorus. In the rays beyond the red extremity, phosphorus is heated, smokes, and emits white fumes; but these are presently suppressed on exposing it to the de-oxydizing rays which lie beyond the violet extremity.

There is an exception, however, as stated by Dr. Wollaston, to the de-oxydizing power of the rays above-mentioned. The substance, termed gum-guiacum, has the property, when exposed to the light, of changing from a yellowish colour to green; and this effect he has ascertained to be connected with the absorption of oxygen. Now in the most refrangible rays, which would fall beyond the violet extremity, he found that this substance became green, and was again changed to yellow by the least refrangible. This is precisely the reverse of what happens to muriate of silver, which is blackened, or de-oxydized, by the most

refrangible; and has its colour restored, or is again oxygenized, in the least refrangible rays.

Certain bodies have the property of absorbing the rays of light in their totality, of retaining them for some time, and of again evolving them unchanged, and unaccompanied by sensible heat. Thus, in an experiment of Du Fay, a diamond exposed to the sun, and immediately covered with black wax, shone in the dark, on removing the wax, at the expiration of several months. Bodies possessing this property, are called *solar phosphori*: such are Canton's, Baldwin's, Homberg's, and the Bolognian phosphori. To the same class belong several natural bodies which retain light, and give it out unchanged. Thus, snow is a natural solar phosphorus. So also is, occasionally, the sea when agitated; putrid fish have a similar property; and the glow-worm belongs to the same class. These phenomena are independent of every thing like combustion; for artificial phosphori, after exposure to the sun's rays, shine in the dark when placed in the vacuum of an air-pump, or under water, &c. where no air is present to effect combustion.

From solar phosphori, the extrication of light is facilitated by the application of an elevated temperature; and, after having ceased to shine at the ordinary temperature, they again emit light when exposed to an increase of heat. Several bodies, which do not otherwise give out light, evolve it, or become phosphorescent when heated. Thus, powdered fluate of lime becomes luminous when thrown on an iron plate, raised to a temperature rather above that of boiling water. The yolk of an egg, when dried, becomes luminous on being heated; and so also does tallow during liquefaction. To exhibit the last mentioned fact, it is merely necessary to place a lump of tallow on a coal, heated below ignition, making the experiment in a dark room. Attrition also evolves light, in many instances, by the part rubbed becoming ignited. Thus, rock crystal, and other hard stones, shine when rubbed against each other; and two pieces of common bonnet cane, rubbed strongly against each other in the dark, emit a faint light; most probably from the silex they contain: and two pieces of borax have the same property much more remarkably.

Light is disengaged in various cases of chemical combination. Whenever combustion is a part of the phenomena, this is well known to happen; but light is evolved also, in other instances, where nothing like combustion goes forwards. Thus, fresh-prepared pure magnesia, added suddenly to highly concentrated sulphuric acid, exhibits a red heat.

Whence comes the light afforded by ignited bodies? whether it have been previously imbibed by them? whether the commencement of ignition be distinctive of the same temperature in all bodies? whether the great planetary sources of light be bodies in a state of combustion, or merely luminous upon principles very different from any which our experiments can point out? whether the momentum of the particles of light, or their disposition for chemical combination, be the most effectual in the changes produced by its agency?—these, and numerous other interesting questions, must be left for future research and investigation. See COMBUSTION.

The production of light by inflammation is an object of great importance to society at large, as well as to the chemist. It appears to arise immediately from the strong ignition of a body while rapidly decomposing. Most solid bodies in combustion are kept, partly from a want of the access of air, and partly from the vicinity of conducting bodies, at a low degree of ignition. But when vapours rapidly escape into the air, it may, and does frequently happen, that the combustion, instead of being carried on merely at the surface of the mass, penetrates to a considerable depth within, and from this, as well as from the imperfect conducting power of the surrounding air, a white heat, or very strong ignition, is produced. The effect of lamps and candles depends upon these considerations. A combustible fluid, most commonly of the nature of fat oil, is put in a situation to be absorbed between the filaments of cotton, linen, fine wire, or asbestos. The extremity of this fibrous substance, called the wick, is then considerably heated. The oil evaporates, and its vapour takes fire. In this situation the wick, being enveloped with flame, is kept at such a temperature, that the oil continually boils, is evaporated, burns, and by these means keeps up a constant flame. Much of the perfection of this experiment depends on the nature, quantities, and figure of the materials made use of. If the wick be too large, it will supply a greater quantity of the fluid than can be well decomposed. Its evaporation will therefore diminish the temperature, and

consequently the light, and afford a fuliginous column, which will pass through the centre of the flame, and fly off in the form of smoke. The magnitude of the wick may, from time to time, in candles, be reduced, as to length, by snuffing; but this operation will not remedy the evils which arise from too great a diameter. If the oil be not sufficiently combustible, the ignition will be but moderate, and the flame yellow; and the same effect will be produced, if the air be not sufficiently pure and abundant. An experiment to this effect may be made by including the flame of a small candle or lamp in a glass tube of about one inch in diameter, standing on the surface of a table. The air which passes between the glass and the table, will be sufficient to maintain a very bright flame; but if a metallic covering, perforated with a hole of about a quarter of an inch diameter, be laid upon the upper orifice of the tube, the combustion will be so far impeded, that the flame will be perceptibly yellower. The hole may then be more or less closed at pleasure by sliding a small piece of metal, for example a shilling, over it. The consequence will be, that the flame will become more and more yellow, will at length emit smoke, and if the hole be entirely closed, extinction will follow.

The smell arising from the volatile parts, which pass off not well consumed from a lamp or candle, must be different according to the nature of those parts. This depends chiefly on the oil, but in some measure upon the wick. When a candle with a cotton wick is blown out, the smell is considerably more offensive, than if the wick be of linen, or of rush; but less offensive than if the supply of the combustion had been oil. Whenever a candle or lamp is removed, the combustion is in some measure impeded by the stream of cold air, against which it strikes. Smoke is accordingly emitted from its anterior side, and the peculiar smell is perceived. From this imperfection, lamps are much less adapted to be carried from place to place than candles.

From the necessity of the access of air, there will be more light produced from a lamp with a number of small wicks, than with one large one, or from a number of small candles, than the same quantity of tallow used to make a single large one. In the lamp of Argand, the wick consists of a web of cloth in the form of a pipe or tube, the longitudinal fibres of which are thicker than the circular ones. This is passed by a suitable contrivance into a cylindrical cavity, which contains the oil; and there are other precautions in the construction of the apparatus, by which the oil is regularly supplied, the access of air is duly permitted, as well within as without the circle formed by the upper edge of this cylindrical wick, and this edge can be raised or lowered at pleasure. Hence the possessor has it in his power to regulate the surface of the wick, so that the greatest flame consistent with perfect combustion may be produced; and the steadiness of the flame is secured by a glass shade or tube, which surrounds it, and in a certain degree accelerates the current of air.

In the illumination by candles, where the fused matter is contained in a cup or cavity of the matter not yet fused, it is of some consequence, whether the substance be fusible at a high or low temperature. The difference between wax and tallow candles arises from this property. Wax being less fusible, will admit of a thinner wick, and needs no snuffing; but in a tallow candle it is absolutely necessary to have a large wick, capable of taking up the tallow as it melts.

The difference of effect in illumination between a thick and a thin wick cannot be better shown, than by remarking the appearances produced by both. When a candle with a thick wick is first lighted, and the wick snuffed short, the flame is perfect and luminous, unless its diameter be very great; in which last case, there is an opaque part in the middle, where the combustion is impeded for want of air. As the wick becomes longer, the space between its upper extremity and the apex of the flame is diminished; and, consequently, the oil, which issues from that extremity, having a less space of ignition to pass through, is less completely burned, and passes off partly in smoke. This evil continues to increase, until at length the upper extremity of the wick projects beyond the flame, and forms a support for an accumulation of soot, which is afforded by the imperfect combustion. A candle in this situation affords scarcely one-tenth of the light, which the due combustion of its materials would produce; and tallow candles, on this account, require continual snuffing. But, on the contrary, if we consider the wax candle, we find, that as its wick lengthens, the light indeed becomes less, and the cup becomes filled with melted wax. The wick, however, being thin and flexible, does not long

occupy its place in the centre of the flame; neither does it, when there, enlarge the diameter of the flame, so as to prevent the access of air to its internal part. When its length is too great for the vertical position, it bends on one side; and its extremity, coming into contact with the air, is burned to ashes, excepting such a portion as is defended by the continual afflux of melted wax, which is volatilized and completely burned by the surrounding flame. We see, therefore, that the difficult fusibility of wax renders it practicable to burn a large quantity of fluid by means of a small wick; and that this small wick, by turning on one side in consequence of its flexibility, performs the operation of snuffing upon itself, in a much more accurate manner than it can ever be performed mechanically.

Mr. Henry made some experiments on the light afforded by the combustion of different gases, and found, that it was apparently in the ratio of the oxygen that entered into combination with the hydrogen they contained. Thus, 100 parts of pure hydrogen gas required from 50 to 54 of oxygen; 100 of gas from oak, 42; from moist charcoal and from dried peat, each 50; from lamp oil 156; from coal 140; from wax 166; pure olifiant gas 210. Tallow is nearly on a par with oil. The production of light from the first four was so trifling, that they did not seem applicable to œconomical purposes.

Light *from plants.* In Sweden a very curious phenomena has been observed on certain flowers by M. Haggern, lecturer in natural history. One evening he perceived a faint flash of light repeatedly dart from a marigold. Surprised at such an uncommon appearance, he resolved to examine it with attention; and, to be assured it was no deception of the eye, he placed a man near him, with orders to make a signal at the moment when he observed the light. They both saw it constantly at the same moment. The light was most brilliant on marigolds of an orange or flame colour; but scarcely visible on pale ones. The flash was frequently seen on the same flower two or three times in quick succession, but more commonly at intervals of several minutes: and when several flowers in the same place emitted their light together, it could be observed at a considerable distance. This phenomenon was remarked in the months of July and August at sunset, and for half an hour when the atmosphere was clear; but after a rainy day, or when the air was loaded with vapours, nothing of it was seen. The following flowers emitted flashes, more or less vivid, in this order: 1. The marigold, calendula officinalis. 2. Monk's-hood, tropæolum majus. 3. The orange lily, lilium bulbiferum. 4. The Indian pink, tagetes patula et erecta.

To discover whether some little insects or phosphoric worms might not be the cause of it, the flowers were carefully examined, even with a microscope, without any such thing being found. From the rapidity of the flash, and other circumstances, it may be conjectured that there is something of electricity in this phenomenon. It is well known, that when the pistil of a flower is impregnated, the pollen bursts away by its elasticity, with which electricity may be combined. But M. Haggern, after having observed the flash from the orange lily, the antheræ of which are a considerable space distant from the petals, found that the light proceeded from the petals only; whence he concludes, that this electric light is caused by the pollen, which, in flying off, is scattered on the petals. Whatever be the cause, the effect is singular and highly curious.

Light *house*, a building erected upon a cape or promontory on the sea coast, or upon some rock in the sea, and having on its top in the night-time a great fire, or light formed by candles, which is constantly attended by some careful person, so as to be seen at a great distance from the land. It is used to direct the shipping on the coast, that might otherwise run a-shore, or steer an improper course, when the darkness of the night and the uncertainty of currents, &c. might render their situation with regard to the shore extremely doubtful. Lamp-lights are, on many accounts, preferable to coal fires or candles; and the effect of these may be increased by placing them either behind glass hemispheres, or before properly disposed glass or metal reflectors, which last method is now very generally adopted. See Beacons.

LIGHTFOOTIA, in botany, so named in honour of John Lightfoot, a genus of the Polygamia Dioecia class and order. Essential character: calyx four-leaved; corolla none: female and hermaphrodite, stigma sessile; berry umbilicated, one-celled, with from three to six seeds. There are three species, all shrubs.

LIGHTNING. It is now universally allowed, that lightning is really an electrical explosion or phenomenon. Philoso-

phers had not proceeded far in their experiments and inquiries on this subject, before they perceived the obvious analogy between lightning and electricity, and they produced many arguments to evince their similarity. But the method of proving this hypothesis, beyond a doubt, was first proposed by Dr. Franklin, who, about the close of the year 1749, conceived the practicability of drawing lightning down from the clouds. Various circumstances of resemblance between lightning and electricity were remarked by this philosopher, and have been abundantly confirmed by later discoveries, such as the following: Flashes of lightning are usually seen crooked and waving in the air; so the electric spark drawn from an irregular body at some distance, and when it is drawn by an irregular body, or through a space in which the best conductors are disposed in an irregular manner, always exhibits the same appearance. Lightning strikes the highest and most pointed objects in its course, in preference to others, as hills, trees, spires, masts of ships, &c. so all pointed conductors receive and throw off the electric fluid more readily than those that are terminated by flat surfaces. Lightning is observed to take and follow the readiest and best conductor; and the same is the case with electricity in the discharge of the Leyden phial; from whence the Doctor infers, that in a thunder-storm it would be safer to have one's clothes wet than dry. Lightning burns, dissolves metals, rends some bodies, sometimes strikes persons blind, destroys animal life, deprives magnets of their virtue, or reverses their poles; and all these are well-known properties of electricity.

To demonstrate, however, by actual experiment, the identity of the electric fluid with the matter of lightning, Dr. Franklin contrived to bring lightning from the heavens by means of a paper kite, properly fitted up for the purpose, with a long fine wire string, and called an electrical kite, which he raised when a thunder storm was perceived to be coming on: and with the electricity thus obtained, he charged phials, kindled spirits, and performed all other such electrical experiments as are usually exhibited by an excited glass globe or cylinder. This happened in June, 1752, a month after the electricians in France, in pursuance of the method which he had before proposed, had verified the same theory, but without any knowledge of what they had done. The most active of these were Messrs. Dalibard and Delor, followed by M. Mazeas, and M. Monnier.

Nor had the English philosophers been inattentive to this subject. Mr. Canton, however, succeeded in July, 1752; and in the following month Dr. Bevis and Mr. Wilson observed nearly the same appearances as Mr. Canton had done before. By a number of experiments Mr. Canton also soon after observed, that some clouds were in a positive, while some were in a negative state of electricity; and that the electricity of his conductor would sometimes change from one state to the other five or six times in less than half an hour.

How it happens that particular parts of the earth, or the clouds, come into the opposite states of positive and negative electricity, is a question not absolutely determined: though it is easy to conceive that when particular clouds, or different parts of the earth, possess opposite electricities, a discharge will take place within a certain distance; or the one will strike into the other, and in the discharge a flash of lightning will be seen. Mr. Canton queries whether the clouds do not become possessed of electricity by the gradual heating and cooling of the air; and whether air suddenly rarefied may not give electric fire to clouds, and vapours passing through it, and air suddenly condensed receive electric fire from them. Mr. Wilcke supposes, that the air contracts its electricity in the same manner that sulphur and other substances do, when they are heated and cooled in contact with various bodies. Thus, the air being heated or cooled near the earth, gives electricity to the earth, or receives it from it; and the electrified air being conveyed upwards by various means, communicates its electricity to the clouds. Others have queried, whether, since thunder commonly happens in a sultry state of the air, when it seems charged with sulphureous vapours, the electric matter then in the clouds may not be generated by the fermentation of sulphureous vapours with mineral or acid vapours in the air. With regard to places of safety in times of thunder and lightning, Dr. Franklin's advice is, to sit in the middle of a room, provided it be not under a metal lustre suspended by a chain, sitting on one chair, and laying the feet on another. It is still better, he says, to bring two or three mattresses, or beds, into the middle of the room, and folding them double, to place the chairs upon them; for as they are not so good conductors as the walls, the light-

ning will not be so likely to pass through them. But the safest place of all is in a hammock hung by silken cords, at an equal distance from all the sides of the room. Dr. Priestley observes, that the place of most perfect safety must be the cellar, and especially the middle of it; for when a person is lower than the surface of the earth, the lightning must strike it before it can possibly reach him. In the fields, the place of safety is within a few yards of a tree, but not quite near it. Beccaria cautions persons not always to trust too much to the neighbourhood of a higher or better conductor than their own body, since he has repeatedly found that the lightning by no means descends in one undivided track, but that bodies of various kinds conduct their share of it at the same time, in proportion to their quantity and conducting power. See Franklin's Letters, Beccaria's Lettre dell' Ellettricessimo, Priestley's History of Electricity, and Lord Mahon's Principles of Electricity.

Lord Mahon observes, that damage may be done by lightning, not only by the main stroke and lateral explosion, but also by what he calls the returning stroke, by which is meant the sudden and violent return of that part of the natural share of electricity which had been gradually expelled from some body or bodies, by the superinduced elastic, electrical pressure of the electrical atmosphere of a thunder-cloud.

The ancient notion of a thunderbolt, or stony mass, falling at the stroke of lightning, seems to have obtained no small degree of force from the modern observations and researches concerning stones which have fallen from the atmosphere. See Stones, *meteoric*. From which it appears, that other substances as well as water are not unfrequently condensed and precipitated from the air, and exhibit the most astonishing degrees of heat and electricity during their condensation.

LIGNUM *vitæ*. The lignum vitæ tree is a native of the West Indies, and the warmer parts of America: there is also a species, a native of the Cape of Good Hope. It is a large tree, rising at its full growth to the height of forty feet, and measuring from fifteen to eighteen inches in diameter; having a hard, brittle, brownish bark, not very thick. The wood is firm, solid, ponderous, very resinous, of a blackish yellow colour in the middle, and a hot aromatic taste. It is so hard as to break the tools which are employed in felling it; and is, therefore, seldom used as firewood, but is of great use to the sugar-planters for making wheels and cogs to the sugar-mills. It is also frequently wrought in bowls, mortars, and other utensils. It is imported into England, in large pieces of four or five hundred weight each, and from its hardness and beauty, is in great demand for various articles in the turnery ware, and for trucks of ship blocks. The wood, gum, bark, fruit, and even the flowers of this plant, have been found to possess medicinal virtues.

LIGULA, in natural history, a genus of the Vermes Intestina. Body linear, equal, long; the fore-part obtuse; the hind-part acute, with an impressed dorsal suture. There are two species, *viz.* L. intestinalis, L. abdominalis; the former is found in the intestines of the merganser and guillemot: about a foot long, and exactly resembling a piece of tape: of the latter there are, at least, eight varieties described as inhabiting the intestines of fish: they are found principally in the mesentery, emaciating the fish they infest, and causing them to grow deformed. When they escape from the body they penetrate through the skin: they are sometimes solitary, and sometimes gregarious, about half a line thick, and from six inches to five feet long.

LIGUSTICUM, in botany, *lovage*, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ, or Umbelliferæ. Essential character: fruit oblong, five-grooved on both sides; corolla equal, with involute entire petals. There are eight species, of which L. levisticum, common lovage, has a strong, fleshy, perennial root, striking deep into the ground, composed of many strong fleshy fibres, covered with a brown skin, possessing a hot aromatic smell and taste. The leaves are large, composed of many leaflets, shaped like those of Smallage, but larger and of a deeper green; stems six or seven feet high, large and channelled, dividing into several branches, each terminated by a large umbel of yellow flowers. It is a native of the Alps, of Italy, the South of France, Silesia, &c.

LIGUSTRUM, in botany, *privet*, a genus of the Diandria Monogynia class and order. Natural order of Sepiariæ. Jasmineæ, Jussieu. Essential character: corolla four-cleft; berry four-seeded. There are three species, of which L. vulgare, common privet, is a shrub about six feet in height, branched, the bark of a greenish-ash colour, irregularly sprinkled, with numerous pro-

minent points; branches opposite, the young ones flexible and purplish; leaves opposite, on short petioles, smooth on both sides; panicle about two inches in length, somewhat pyramidal; corolla white, but soon changes to a reddish-brown. Privet is found wild in most parts of Europe, and in Japan, in woods and hedges; it flourishes best in a moist soil.

LIKE *quantities*, or SIMILAR *quantities*, in algebra, are such as are expressed by the same letters, to the same power, or equally repeated in each quantity; though the numeral co-efficient may be different: thus, $4a$ and $5a$ are like quantities; so also are $3x^2$ and $9x^2$; and likewise $5bdy^2$ $10bdy^2$. But $4a$ and $8b$ are not like quantities; nor are $4a$ and $4a^2$.

LIKE *figures*, the same as SIMILAR *figures*. All like figures have their homologous lines in the same ratio. Like plane figures are in the duplicate ratio, or as the squares of their homologous lines or sides; and like solid figures are in the triplicate ratio, or as the cubes of their homologous sides.

LILIUM, in botany, *lily*, a genus of the Hexandria Monogynia class and order. Natural order of Coronariæ. Lilia, Jussieu. Essential character: corolla six-petalled, bell-shaped, with a longitudinal nectareous line; capsule, the valves connected by cancellated hairs. There are eleven species, with many varieties, L. candidum, common white lily, has a large bulb, from which proceed several succulent fibres; it has a stout, round, upright stem, usually three feet in height; leaves long and numerous, smooth and sessile; flowers white, terminating the stem in a cluster, on short peduncles; petals within of a beautiful shining white, on the outside ridged, and less luminous. Native of the Levant.

LILLY (WILLIAM), in biography, a noted English astrologer, born in Leicestershire in 1602. His father was not able to give him further education than common reading and writing; but young Lilly being of a forward temper, and endued with shrewd wit, he resolved to push his fortune in London, where he arrived in 1620, and, for a present support, articled himself as a servant to a mantua-maker in St. Clement Danes. But in 1624 he moved a step higher, by entering into the service of Mr. Wright, in the Strand, master of the Salters' Company, who not being able to write, Lilly, among other offices, kept his books. On the death of his master, in 1627, Lilly paid his addresses to the widow, whom he married with a fortune of one thousand pounds.

Being now his own master, he followed the bent of his inclinations, which led him to follow the puritanical preachers. Afterwards turning his mind to judicial astronomy, in 1632 he became pupil, in that art, to one Evans, a profligate Welsh parson; and the next year gave the public a specimen of his skill, by an intimation that the King had chosen an unlucky horoscope for the coronation in Scotland. In 1634, getting a manuscript copy of the "Ars Noticia" of Cornelius Agrippa, with alterations, he drank in the doctrine of the magic circle, and the invocation of spirits, with great eagerness, and practised it for some time; after which he treated the mystery of recovering stolen goods, &c. with great contempt, claiming a supernatural sight, and the gift of prophetical predictions; all which he well knew how to turn to good advantage.

Meanwhile he had buried his first wife, purchased a moiety of thirteen houses in the Strand, and married a second wife, who, joining to an extravagant temper, a termagant spirit which he could not lay, made him unhappy, and greatly reduced his circumstances.

With this uncomfortable yoke-mate he removed, in 1636, to Hersham, in Surrey, where he staid till 1641; when, seeing a prospect of fishing in troubled waters, he returned to London. Here, having purchased several curious books in this art, which were found on pulling down the house of another astrologer, he studied them incessantly, finding out secrets contained in them, which were written in an imperfect Greek character, and, in 1644, he published his "Merlinus Anglicus," an almanack, which he continued annually till his death, and several other astrological works, devoting his pen, and other labours, sometimes to King Charles's party, and at others to that of the parliament, but mostly to the latter, raising his fortune by favourable predictions to both parties, at one time by presents, and at others by pensions. Thus, in 1648, the council of state gave him in money fifty pounds, and a pension of one hundred pounds per annum, which he received for two years, and then resigned it on some disgust.

By his advice and contrivance, the King attempted several times to make his escape from confinement; he procured and sent the aqua fortis, and files to cut the iron bars

of his prison windows at Carisbrook Castle; but still advising and writing for the other party at the same time. Meanwhile he read public lectures on astrology in 1648 and 1649, for the improvement of young students in that art; and, in short, plied his business so well, that, in 1651 and 1652, he laid out two thousand pounds for lands and a house at Hersham.

During the siege of Colchester, he and Booker were sent for thither to encourage the soldiers; which they did by assuring them that the town would soon be taken; which proved true in the event.

Having, in 1650, written publicly that the parliament should not continue, but a new government arise; agreeably to which, in his almanack for 1653, he asserted that the parliament stood upon a ticklish foundation, and that the commonalty and soldiery would join together against them. Upon which he was summoned before the committee of plundered ministers; but receiving notice of it before the arrival of the messenger, he applied to his friend Lenthal, the Speaker, who pointed out the offensive passages. He immediately altered them, attended the committee next morning, with six copies printed, which six alone he acknowledged to be his, and by that means came off with only thirteen days custody by the serjeant at arms. This year he was engaged in a dispute with Mr. Thomas Gataker.

In 1665, he was indicted at Hicks's Hall for giving judgment upon stolen goods, but was acquitted. In 1659, he received from the King of Sweden a present of a gold chain and medal, worth about fifty pounds, on account of his having mentioned that monarch with great respect in his almanacks of 1657 and 1658.

After the Restoration in 1660, being taken into custody, and examined by a committee of the House of Commons, touching the execution of Charles I., he declared that Robert Spavin, then secretary to Cromwell, dining with him soon after the fact, assured him, it was done by Cornet Joyce. The same year he sued out his pardon, under the broad seal of England, and afterwards continued in London till 1665, when, upon the raging of the plague there, he retired to his estate at Hersham. Here he applied himself to the study of physic, having, by means of his friend Elias Ashmole, procured from Archbishop Sheldon a licence to practise it, which he did, as well as astrology, from thence till the time of his death. In October, 1666, he was examined before a committee of the House of Commons, concerning the fire of London, which happened in September that year. A little before his death he adopted for his son, by the name of Merlin Junior, one Henry Coley, a tailor by trade; and at the same time gave him the impression of his almanack, which had been printed for thirty-six years successively. This Coley became afterwards a celebrated astrologer, publishing in his own name almanacks and books of astrology, particularly one entitled "A Key to Astrology."

Lilly died of the palsy in 1681, at seventy-nine years of age; and his friend Mr. Ashmole placed a monument over his grave in the church of Walton upon Thames.

Lilly was the author of many works. His "Observations on the Life and Death of Charles, late King of England," if we overlook the astrological nonsense, may be read with as much satisfaction as more celebrated histories, Lilly being not only very well informed, but strictly impartial. This work, with the lives of Lilly and Ashmole, written by themselves, were published in one volume 8vo. in 1774, by Mr. Burman. His other works were principally as follow.

1. Merlinus Anglicus, junior. 2. Supernatural Sight. 3. The White King's Prophecy. 4. England's prophetical Merlin: all printed in 1644. 5. The starry Messenger, 1645. 6. Collection of Prophecies, 1646. 7. A Comment on the White King's Prophecy, 1646. 8. The Nativities of Archbishop Laud and Thomas Earl of Strafford, 1646. 9. Christian Astrology, 1647: upon this piece he read his lectures in 1648, mentioned above. 10. The third Book of Nativities, 1647. 11. The World's Catastrophe, 1647. 12. The Prophecies of Ambrose Merlin, with a Key, 1647. 13. Trithemius, or the Government of the World by presiding Angels, 1647. 14. A Treatise of the Three Suns seen in the Winter of 1647, printed in 1648. 15. Monarchy or no Monarchy, 1651. 16. Observations on the Life and Death of Charles, late King of England, 1651; and again in 1657, with the title of Mr. William Lilly's true History of King James and King Charles I., &c. 17. Annus Tenebrosus, or the Black Year. This drew him into the dispute with Gataker, which Lilly carried on in his Almanack in 1654.

LIMAX, in natural history, the *slug*. Body oblong, creeping, with a fleshy kind

of shield above, and a longitudinal flat dish beneath; aperture placed on the right side, within the shield; four feelers, situate above the mouth, with an eye at the tip of each of the larger ones. There are sixteen species; L. lævis: body black, and almost without wrinkles, found among the moss late in the autumn, five lines long; body glossy, with undulate, transverse striæ on the shield; narrower and not so much wrinkled as the next. L. ater; body black and furrowed with deep wrinkles: of this species there are five or six varieties, differing in colour and size; the dusky-brown with a yellowish mouth, a streak on each side; is found in woods, meadows, fields, and gardens; is from one and a half to five inches long; crawls slowly, and leaves a slime upon whatever it passes over. L. alba, is white, and is found in woods and groves; from three to five inches long. L. hyalinus; body hyaline; feelers obsolete, with a brown line reaching from the feelers to the shield; inhabits mossy places, and is very destructive to the young shoots of kidney-beans; belly with numerous interrupted wrinkles. L. agrestes; body whitish, with black feelers: five varieties, of which some have the power of secreting a large quantity of mucous from the under surface, and forming it into a thread like a spider's web; by this means it often suspends itself, and descends from the branches of trees, or any height it had crawled up to. It is found in gardens, pastures, and groves, from May till December. One of the varieties of this species is that which has been recommended to be swallowed by consumptive persons; it is half an inch long, and when touched it sticks as if dead to the fingers.

LIME, or calcareous earth, predominates in most stones which are soft enough to be scratched with a knife. These are chalk, lime-stone, marble, spars, gypsum, or plaster-stone, and various others. As the lime is most frequently combined with carbonic acid, it is usual for mineralogists to drop a small quantity of nitric acid upon the stones they are desirous of classing; and if they froth by the escape of the acid, they conclude that lime enters into the composition. To obtain pure calcareous earth, powdered chalk must be repeatedly boiled in water, which will deprive it of the saline impurities it frequently contains. It must then be dissolved in distilled vinegar, and precipitated by the addition of concrete volatile alkali. The precipitate, when well washed and dried, will consist of lime united to carbonic acid; the latter of which may be driven off by heat, if necessary.

If chalk, marble, lime-stone, spar, or any other specimens of this earth, containing carbonic acid, be exposed to continued ignition, they give out carbonic acid and water, to the amount of nearly half their weight. The remainder, consisting chiefly of lime, has a strong tendency to combination, and attracts water very powerfully. The addition of water to lime produces a very considerable heat, attended with noise, and agitation of the parts, which break asunder; a considerable vapour arises, which carries up with it part of the lime; and a phosphoric light is seen, if the experiment be made in the dark. Lime thus saturated with water is said to be flaked. Water dissolves about one five-hundredth part of its weight of lime, and is then called lime-water. This solution has an acrid taste, and turns syrup of violets to a green colour. If lime-water be exposed to the open air, the lime attracts carbonic acid, and is by this means converted into chalk; which, not being soluble in water, forms a crust on the surface, formerly called cream of lime, which, when of a certain thickness, breaks, and falls to the bottom: and in this way the whole of the lime will in time be separated. If the fire have been too violent in the burning of lime, the stones become hard, sonorous, and incapable of absorbing water with the requisite degree of avidity. This effect seems to arise from part of the calcareous earth having entered into fusion with the clay, flint, or other contaminating earths, with which it forms a glass that covers and defends the rest.

The paste of lime and water, called mortar, has a degree of adhesion and ductility, though much less than clay. When dry, it is more or less friable, like chalk. A mixture of sand, or broken earthen vessels, greatly increases its firmness, which it seems to effect by rendering it more difficult for the parts to be removed with respect to each other. When mortar is left to dry by the gradual evaporation of its superfluous water, it is very long before it obtains its utmost degree of firmness. But if dry quick-lime be mixed with mortar, it gradually absorbs the superfluous water, and the mass becomes solid in a very short time. See MORTAR.

Lime has an affinity for tannin, whence it is probable that a portion of it is retained in tanned leather, perhaps not to the improvement of its quality. It has an edul-

corative power with respect to animal oils, by combining with the putrid gelatine in them; but its action on them in forming a soap is too strong to admit of its being used for this purpose with advantage, unless in small quantities. Feathers, however, may be very conveniently cleaned by steeping three or four days in strong lime-water, and afterward washing and drying them.

Though infusible in the strongest heats of our furnaces, it is nevertheless a very powerful flux with regard to mixtures of the other earths. These are all fusible by a proper addition of lime. Compounds are still more fusible; for any three of the five well-known earths may be fused into perfect glass, if they be mixed together in equal portions, provided the calcareous be one of them.

The earthy part of animals is chiefly, if not altogether, calcareous: in most cases it is united with phosphoric acid, but frequently with the carbonic.

LIME-*stone.* The native indurated carbonate of lime. It is usually more or less bluish from iron, and of a granulated fracture; and it is connected with lime by ignition in lime-kilns, for the purpose of making mortar. See LIME; also MORTAR.

LIMEUM, in botany, a genus of the Heptandria Digynia class and order. Natural order of Holoracæ. Portulaceæ, Jussieu. Essential character: calyx five-leaved; petals five, equal; capsule globular, two-celled. There are three species, all natives of the Cape of Good Hope.

LIMIT, in a restrained sense, is used by mathematicians for a determinate quantity to which a variable one continually approaches; in which sense the circle may be said to be the limit of its circumscribed and inscribed polygons. In algebra, the term limit is applied to two quantities, one of which is greater, and the other less, than another quantity; and in this sense it is used in speaking of the limits of equations, whereby their solution is much facilitated.

Let any equation, as $x^3 - px^2 \times qx - r = o$ be proposed; and transform it into the following equation:

$$\left.\begin{array}{r} y^3 + 3ey^2 + 3e^2y + e^3 \\ - py^2 - 2pey - pe^2 \\ + qy + qe \\ - r \end{array}\right\} = o.$$

Where the values of y are less than the respective values of x, by the difference e. If you suppose e to be taken such as to make all the coefficients of the equation of y positive, viz. $e^3 - pe^2 + qe - r$, $3e^2 - 2pe + q$, $3e - p$; then there being no variation of the signs in the equation, all the values of y must be negative; and consequently the quantity e, by which the values of x are diminished, must be greater than the greatest positive value of x; and, consequently, must be the limit of the roots of the equation $x^3 - px^2 + qx - r = o$.

It is sufficient, therefore, in order to find the limit, to inquire what quantity substituted for x, in each of these expressions $x^3 - px^2 + qx - r$, $3x^2 - 2px + q$, $3x - p$, will give them all positive; for the quantity will be the limit required.

Having found the limit that surpasses the greatest positive root, call it m. And if you assume $y = m - x$, and for x substitute $m - y$, the equation that will arise will have all its roots positive; because m is supposed to surpass all the values of x, and consequently $m - x$ ($= y$) must always be affirmative. And, by this means, any equation may be changed into one that shall have all its roots affirmative.

Or, if $-n$ represent the limit of the negative roots, then by assuming $y = x + n$ the proposed equation shall be transformed into one that shall have all its roots affirmative; for $+n$ being greater than any negative value of x, it follows that $y = x + n$ must be always positive.

What is here said of the above cubic equation, may be easily applied to others; and of all such equations, two limits are easily discovered, *viz.* o, which is less than the least; and e, found as above, which surpasses the greatest root of the equation. But besides these, other limits still nearer the roots may be found; for the method of doing which, the reader may consult Maclaurin's Algebra.

LIMITATION, a certain time prescribed by statute, within which an action must be brought, which is generally twofold; first in writs, by several acts of parliament, and, secondly, to make a title to any inheritance, and that is by the common law.

On penal statutes, all actions, suits, bills, indictments, or informations, for any forfeiture limited to the king, his heirs or successors only, shall be brought within two years after the offence committed, and not after. All such actions, &c. except the statutes of tillage, which give the penalty to the king and a common informer, are limited to one year next after the offence committed; and if not sued for by the informer, they may be sued for by the king, any time within the two years, after that

year is ended: and where a shorter time is limited by any penal statute, the prosecution must be within that time. 31 Eliz. c. 5.

All actions of trespass, of assault, battery, wounding, imprisonment, or any of them, are to be commenced within four years next after the cause of such actions or suits, and not after: 21 James I. c. 16. All actions of trespass, *quare clausum fregit;* all actions of trespass, detinue, trover, and replevin; all actions of account, and upon the case, (other than such accounts as concern the trade of merchandise between merchant and merchant); all actions of debt, grounded upon any lending, or contract without specialty (that is, not being by deed or under seal); all actions of debt for arrearages of rent; and all actions of assault, menace, battery, wounding, and imprisonment, shall be commenced within the time and limitation as followeth, and not after: that is to say, the said actions upon the case (other than for slander), and the said actions for account, and the said actions for trespass, debt, detinue, and replevin, and the said action for trespass *quare clausum fregit*, within six years after the cause of such action: 21 James I. c. 16. In all these statutes there is an exception in relation to infants, lunatics, and femes coverts, allowing them a further time after they are in a situation which enables them to sue. As to the exception with respect to merchant's accounts, it extends to actions on accounts current only, in which the giving credit on one side is an acknowledgement of the debt on the other; but when the account is settled between merchant and merchant, it must be sued for like any other debt; and if all the articles are on one side, the account is not taken out of the statute. An acknowledgment of the debt prevents the operation of the statute of limitations, and also a payment upon account; but as it is convenient that suits should not be delayed so long that vouchers cannot be produced, settlements should regularly be enforced. A writ also may be sued out to save the statute of limitation, as it is called, and though never sued, yet, if it is regularly entered, and continued upon the record, the suit may be effectually prosecuted long after, and being commenced within time, the action may be maintained out. This is in conscience rather a mode of evading the statute. It is generally considered as an unfair defence to rely upon the statute, when the party has the actual means of knowing whether the debt is due, and therefore a very slight acknowledgment removes the objection to the suit.

LIMNING, the art of painting in water colours, in contradistinction to painting, which is done in oil colours. See PAINTING.

LIMODORUM, in botany, a genus of the Gynandria Diandria class and order. Natural order of Orchideæ. Essential character: nectary one-leafed, concave, pedicelled, within the lowest petal. There are thirteen species.

LIMONIA, in botany, a genus of the Decandria Monogynia class and order. Essential character: calyx five-parted; petals five; berry three-celled; seeds solitary. There are seven species, of which L. pentaphylla, five-leaved limonia, is an elegant fragrant shrub, very common in most uncultivated lands in Coromandel, but chiefly under large trees, where birds have dropped the seeds. It flowers all the year. The whole plant, when drying in the shade, diffuses a pleasant permanent scent; the flowers are exquisitely fragrant; birds eat the berries greedily.

LIMOSELLA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Preciæ. Lysimachiæ, Jussieu. Essential character: calyx five-cleft; corolla five-cleft, equal; stamina approximating by pairs; capsule one-celled, two-valved, many-seeded. There are two species, *viz.* L. aquatica, common mudwort, or bastard plantain; and L. diandria.

LINCONIA, in botany, a genus of the Pentrandria Digynia class and order. Essential character: petals five, with a nectareous excavation at the base; capsule two-celled. There is but one species, *viz.* L. alopecuroidea, a native of the Cape of Good Hope, in watery places among the mountains.

LINDERA, in botany, so named from J. Linder, a Swede, a genus of the Hexandria Monogynia class and order. Essential character: corolla six-petalled; capsule. There is only one species, *viz.* L. umbellata, a native of Japan.

LINDERNIA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Scrophulariæ, Jussieu. Essential character: calyx five-parted; corolla ringent, with the upper lip very short; stamina the two lower with a terminating tooth, and a sub-lateral

anther; capsule one-celled. There are three species.

LINE, in geometry, a quantity extended in length only, without any breadth or thickness. It is formed by the flux or motion of a point. See FLUXION.

LINES in perspective, are, 1. Geometrical line, which is a right line drawn in any manner on the geometrical plane. 2. Terrestrial line, or fundamental line, is a right line wherein the geometrical plane, and that of the picture or draught intersect one another, formed by the intersection of the geometrical plane, and the perspective plane. 3. Line of the front, is any right line parallel to the terrestrial line. 4. Vertical line, the common section of the vertical and of the draught. 5. Visual line, the line or ray imagined to pass from the object to the eye. 6. Line of station, according to some writers, is the common section of the vertical and geometrical planes. 7. Objective line, the line of an object from whence the appearance is sought for in the draught or picture.

LINES, in dialling, are, 1. Horizontal line, the common section of the horizon and the dial plane. See DIALLING. 2. Horary lines, or hour-lines, the common intersections of the hour-circles of the sphere, with the plane of the dial. See HORARY. 3. Substylar line, that line on which the style or cock of a dial is duly erected, and the representation of such an hour circle as is perpendicular to the plane of that dial. 4. Equinoctial line the common intersection of the equinoctial and plane of the dial.

LINE *of measures*, is used by Oughtred, to denote the diameter of the primitive circle in the projection of the sphere in plano, or that line in which the diameter of any circle to be projected falls. In the stereographic projection of the sphere in plano the line of measures is that line in which the plane of a great circle perpendicular to the plane of the projection, and that oblique circle which is to be projected, intersects the plane of the projection; or it is the common section of a plane passing through the eye point and the centre of the primitive at right angles to any oblique circle which is to be projected, and in which the centre and pole of such circle will be found.

LINE *of direction* on the earth's axis, in the Pythagorean system of astronomy, the line connecting the two poles of the ecliptic and of the equator when they are projected on the plane of the former.

LINE *of direction*, in mechanics, that wherein a body actually moves, or would move, if it were not hindered. It also denotes the line that passes through the centre of gravity of the heavy body to the centre of the earth, which must also pass through the fulcrum, or support of the heavy body, without which it would fall.

LINE *of gravitation*, of any heavy body, a line drawn through its centre of gravity, and according to which it tends downwards.

LINE *of the swiftest descent*, of a heavy body is the cycloid. See CYCLOID.

LINES *on the plain scale*, are the line of chords, line of sines, line of tangents, line of secants, line of semitangents, line of leagues; the construction and application of which see under MATHEMATICAL INSTRUMENTS, SAILING, &c.

LINES *on Gunter's scale*, are the line of numbers, line of artificial sines, line of artificial tangents, line of artificial versed sines, line of artificial sines of rhumbs, line of artificial tangents of the meridian line, and line of equal parts; for the construction and application whereof. See GUNTER's *scale*.

LINES *of the sector*, are the line of equal parts, or line of lines, line of chords, line of sines, line of tangents, line of secants, line of polygons, line of numbers, line of hours, line of latitudes, line of meridians, line of metals, line of solids, line of planes; for the construction and use whereof, see SECTOR.

LINES, in fortification, are those of approach, capital, defence, circumvallation, contravallation, of the base, &c. See APPROACH, &c.

To LINE *a work*, signifies to strengthen a rampart with a firm wall; or to encompass a parapet or moat with good turf, &c.

LINE, in the art of war, is understood of the disposition of an army, ranged in order of battle, with the front extended as far as may be, that it may not be flanked. See ARMY.

LINE *of battle*, is also understood of the disposition of a fleet on the day of engagement, on which occasion the vessels are usually drawn up as much as possible in a straight line, as well to gain and keep the advantage of the wind, as to run the same board.

LINE, *ship of the*, a vessel large enough to be drawn up in the line, and to have a place in a sea-fight. See SHIP.

LINE, in fencing, that part of the body opposite to the enemy, wherein the shoulders, the right arm, and the sword, ought always to be found; and wherein are also to be placed the two feet at the distance of eighteen inches from each other. In which sense a man is said to be in his line, or to go out of his line, &c.

LINE *of the synodical*, in reference to some theories of the moon, is a right line supposed to be drawn through the centres of the earth and sun; and, if it be produced quite through the orbits, it is called the *line of the true syzygies*: but a right line imagined to pass through the earth's centre, and the mean place of the sun, is called the *line of the mean syzygies*.

LINE, in genealogy, a series or succession of relations in various degrees, all descending from the same common father. Direct line, is that which goes from father to son; being the order of ascendants and descendants. Collateral line is the order of those who descend from some common father related to the former, but out of the line of ascendants and descendants: in this are placed uncles, aunts, cousins, nephews, &c.

LINE was also formerly a French measure, containing the twelfth part of an inch, or the hundred and forty-fourth part of a foot. Geometricians conceive the line, notwithstanding its smallness, to be subdivided into six points.

LINES, in music, the name of those strokes drawn horizontally on a piece of paper, on and between which the characters and notes of music are disposed: their number is commonly five; when another is added, for one, two, or more notes, it is called a ledger-line.

LINES, in heraldry, the figures used in armories, to divide the shield into different parts, and to compose different figures. These lines, according to their different forms and names, give denomination to the pieces or figures which they form, except the straight or plain lines.

LINEAR *numbers*, in mathematics, such as have relation to length only; such is a number which represents one side of a plane figure. If the plane figure be a square the linear number is called a root.

LINEAR *problem*, that which may be solved geometrically, by the intersection of two right lines. This is called a simple problem, and is capable but of one solution.

LINEN, in commerce. The linen manufacture was probably introduced into Britain with the first settlements of the Romans. The flax was certainly first planted by that nation in the British soil. The plant itself indeed appears to have been originally a native of the east. The woollen-drapery would naturally be prior in its origin to the linen, and the fibrous plants from which the threads of the latter are produced, seem to have been first noticed and worked by the inhabitants of Egypt. In Egypt, indeed, the linen manufacture appears to have been very early; for even in Joseph's time it had risen to a considerable height. From the Egyptians the knowledge of it proceeded probably to the Greeks, and from them to the Romans. Even at this day the flax is imported among us from the eastern nations; the western kind being merely a degenerate species of it. In order to succeed in the linen manufacture, one set of people should be confined to the ploughing and preparing the soil, sowing and covering the seed, to the weeding, pulling, rippling, and taking care of the new seed, and watering and dressing the flax till it is lodged at home: others should be concerned in the drying, breaking, scutching, and heckling the flax, to fit it for the spinners; and others in spinning and reeling it, to fit it for the weaver: others should be concerned in taking due care of the weaving, bleaching, beetling, and finishing the cloth for the market. It is reasonable to believe, that if these several branches of the manufacture were carried on by distinct dealers in Scotland and Ireland, where our home-made linens are manufactured, the several parts would be better executed, and the whole would be afforded cheaper, and with greater profit.

LING, in ichthyology, the cirrated gadus with two black fins, and with the upper jaw longest; a fish called by authors asellus longus. See GADUS.

LINGUATALA, in natural history, a genus of the Vermes Intestina class and order. Body depressed, oblong; mouth placed before, surrounded with four passages. There is but a single species, *viz.* L. serrata, inhabiting the lungs of the hare.

LINNÆA, in botany, so named in honour of the celebrated Linnæus, a genus of the Didynamia Angiospermia class and order. Natural order of Aggregatæ. Caprifoliæ, Jussieu. Essential character: calyx double, of the fruit two-leaved, of the

flower five-parted, superior; corolla bell-shaped; berry dry, three-celled. There is but one species, *viz.* L. borealis, two-flowered linnæa, a native of the north of Europe.

LINNÆUS, Charles, *(Carl von Linné)* the most eminent naturalist of this age, and the founder of modern botany, was born in 1707, at Rashult, in the province of Smaland, in Sweden, where his father resided as assistant minister to the parish of Stenbrohult. The father, Nils, who was the son of a peasant named Bengtson, had, on going into orders, assumed the name of Linnæus, which was therefore the proper name of young Charles. Nils was attached to the culture of his garden, which he had stocked with some of the rarer plants in that climate, and it is to the delight with which this spot inspired Charles, from his earliest childhood, that he himself ascribes his botanical passion. A remarkable quickness of sight, a hardy constitution, and a retentive memory, gave him the corporeal and mental requisites for indulging his disposition, and thus he was marked out for a naturalist almost from his cradle. His father intending him for his own profession, sent him to the grammar school at Wexio at the age of ten, whence he was removed at the age of seventeen years to the higher seminary, called the gymnasium. In neither of these situations was he distinguished for his proficiency in the ordinary studies of a literary education; but he made a rapid progress in the knowledge of plants, which he ardently pursued, both by frequent excursions in the fields, and by the unwearied perusal of such books on the subject as he was able to procure. When his father, in 1726, came to Wexio for the purpose of inquiring into his improvement, he was much mortified to find his son declared utterly unfit for a learned profession by tutors, who advised that he should be put to some handicraft trade. In this perplexity he applied to the physician, Rothman, who was also lecturer in natural philosophy, the only branch of academic study for which young Linnæus had shewn any inclination. This person discovered in him talents, which though not fitted to make him a theologian, were not ill adapted for another profession, and he proposed that of physic. As the father's circumstances were very narrow, Rothman offered to take the youth gratuitously into his own house during the year that remained for him to finish his course in the gymnasium; he also gave him private instructions in physiology, and put him into a systematic method of studying botany, according to Tournefort's arrangement, which was then looked upon as the most scientific.

In 1727, Linnæus was entered at the University of Lund; he lodged in the house of Stobœus, a physician, who possessed a good library and museum of natural history. He appears here to have paid for his entertainment by various little services, such as that of forming a hortus siccus, and acting as an amanuensis. It was, however, only by accident that his host came to know the extent of his studious ardour. The mother of Stobœus having observed that the candle in his chamber was burning at unseasonable hours, was induced, through fear of fire, to complain of it to her son. Stobœus thereupon entered his chamber at a late hour, and found him diligently occupied with reading. Struck with this proof of his thirst after improvement, he gave Linnæus the free use of his library, and admission to his table. The advice of Rothman, however, caused the young student, in 1728, to quit Lund, and to remove to Upsal for the sake of the superior advantages it afforded. His father advanced him the sum of about eight pounds sterling, which he was informed was all the paternal assistance he was to expect. Thus he was turned out upon the world while yet but a learner in the profession by which he was to get his bread. His little patrimony was soon exhausted, and he was reduced to depend upon chance for a meal. Unable to pay even for the mending of his shoes, he was obliged to patch them himself with folded paper, and notwithstanding his sanguine temper, he could not forbear repenting that he had left his comfortable situation at Lund.

At length, in the autumn of 1729, as he was intently examining some plants in the university garden, he was accosted by Dr. Olof Celsius, professor of divinity, and an eminent naturalist, who was then engaged in preparing a work on the plants mentioned in the scripture. A little conversation soon apprised him of the extraordinary botanical acquisitions of the student, and perceiving his necessitous circumstances, he took him to live in his own house. It was in this year that an account in the Leipsic Commentaries of Vaillant's Treatise on the Sexes of Plants, engaged him in an accurate examination of the stamina and pistils of flowers, and finding a great variety of structure, he conceived the idea of a

new systematic arrangement, founded on the sexual parts. He drew up a treatise on this principle, which was shewn to Celsius, and by him to the botanical professor, Rudbeck, who had the liberality to bestow on it his warmest approbation. As the professor's advanced age made him desirous of a deputy in the office of lecturing, Linnæus, in 1730, was appointed to this office, and was also taken by Rudbeck into his own house as tutor to his sons.

The court of Sweden having issued an order that the academy at Upsal should send a proper person to travel through Lapland, Linnæus, who had a strong inclination to visit that country, was chosen for the office. He set out in May, 1732, very slenderly provided as a scientific traveller, all his baggage with himself being carried on a single horse. This tour would have been much more interesting to science had it been taken when he was further advanced in his studies, and better equipped for making observations. Its chief fruits were a "flora lapponica," and some curious medi- and economical facts.

Having learnt the art of assaying metals at the mines of Calix, he gave lectures on that subject and mineralogy in general, after his return. He improved himself in this branch of knowledge by a visit to the mining country round Fahlun, at the end of 1733. He found, however, that a doctor's degree would be necessary to his further advancement, and in order to obtain this, money was necessary. For this purpose he was advised by a friend to turn his thoughts towards a matrimonial connection with some lady of fortune, and having an introduction to the family of Moræus, the town physician of Fahlun, he ventured to make his addresses to his eldest daughter Elizabeth, and was favourably received. His indigent circumstances gave him little hopes of obtaining the father's consent; but to his surprise he only required a delay until his exertions should open a path to a comfortable settlement. Linnæus therefore resolved to travel in quest of fortune and a degree, and having accumulated his little savings, to which were added those of his faithful Elizabeth, he set out for Holland in the spring of 1735.

At Harderwyck, as the cheapest university, he took the degree of doctor of physic, maintaining for his thesis, "Nova Hypothesis Febrium Intermittentium." He visited Leyden and Amsterdam, and was particularly noticed by Dr. John Frederic Gronovius, who, upon being shewn in manuscript the first sketch of the "Systema Naturæ," requested it might be printed at his own expense. This was accordingly done at Leyden, in 1735, in a tabular form occupying twelve folio pages. By the advice of Gronovius he waited on Boerhaave, who, on conversing with him, became sensible of his singular attainments in botany, and advised him to remain in Holland. Munificence was not among that great man's excellencies, and a verbal message, by way of introduction to Burmann at Amsterdam, was the principal favour that Linnæus received from him. That eminent botanist, who was there engaged on his work on the plants of Ceylon, took the Swede into his house, and treated him with great liberality. His library and collections were of much use to Linnæus, who there published his excellent work, the "Fundamenta Botanica," the basis of his system. While he was in this situation, Mr. Clifford, an opulent merchant of Amsterdam, who had a fine garden of exotics, having heard of the merit of Linnæus from Boerhaave, prevailed upon Burmann to part with him, and took him to his country house at Hartecamp, near Haerlem.

In 1736 Linnæus, at Mr. Clifford's expence, paid a visit to England. There were at that time few distinguished botanists in this country, and Dillenius was the person whom he was most desirous of seeing; Linnæus went to him at Oxford, and at first met with a cool reception, the old botanist having been offended with some of his innovations: after a little conversation, however, he liked him so well, that he detained him a month, and strongly urged him to take up his abode at Oxford and share his salary as professor. Dr. Shaw, the traveller, Martyn, Miller, and Collinson, also showed him much civility; but Sir Hans Sloane did not pay the attention to him which might have been expected from such a votary of natural history. Linnæus returned to Holland enriched with many new plants for Clifford's garden, the description of which, under the title of "Hortus Cliffortianus," appeared in a splendid publication in 1737, drawn up by him and arranged according to his new system. He had already, in the same year, presented to the botanical world the essence of that system in the first edition of his "Genera Plantarum."

In the year 1738, having received intelligence that he was in danger of being

rivalled in his pretensions to his mistress, by the influence another had obtained with her father, he thought it necessary no longer to delay his return. As soon, therefore, as he was able, after his recovery from a severe illness, he took his way through the Low Countries to Paris. At that capital he had recommendations to the Jussieus, who received him with great kindness, and made him known to Reaumur and other eminent naturalists, and showed him all the curiosities of the place. At a visit to the Academy of Sciences, it was announced to him that he was elected a corresponding member. The attachment of the French to the method of their eminent countryman, Tournefort, was unfavourable to the reception of the Linnæan system among them, but he had reason to be satisfied with the personal attention which he experienced. At Rouen he embarked for Sweden, where, on his arrival, he immediately proceeded to Fahlun, and was formally betrothed to the object of his affections. In the month of September he went to Stockholm, in order to try his fortune as a physician; but he found that his fame as a botanist had either not reached thither, or was of no service to him as a practitioner. At length, however, he obtained the confidence of some young men of rank, who gave him considerable employment. A private meeting of men of science being formed in the capital, Linnæus was made an associate, and had the precedency for the first three months: this institution was the parent of the Royal Academy of Stockholm. His reputation made him known to Count Tessin, Marshal of the Diet, by whose influence a salary was conferred upon him, with the condition of his giving public lectures on botany in the summer, and on mineralogy in the winter. That nobleman also procured for him the post of Physician to the Navy, and gave him a general invitation to his table. His affairs now wore so prosperous an aspect, that he would no longer delay his union with his betrothed Anna-Elizabeth Moræa, and they married in June, 1739.

The death of Rudbeck, professor of botany at Upsal, in 1740, opened to Linnæus a prospect of the literary situation which had always been the object of his wishes, in which he might devote himself entirely to the improvement of natural history, uninterrupted by the cares of medical practice. He had, however, a competitor, Rousen, this ancient rival and antagonist, whose superior academical claims obtained the preference. But the resignation of Ronberg, the medical professor, having made another vacancy, that chair was given to Linnæus, with the condition that he and Rousen should divide the business of the two professorships between them; and to the former were allotted the departments of the botanic garden, materia medica, simiology, diætetics, and natural history in general. Before his removal to Upsal, he was engaged by the States to travel through the southern provinces of Sweden, for the purpose of collecting such information as might tend to the improvement of agriculture and manufactures. In this tour he was accompanied by six pupils, and he performed the task to the satisfaction of the States: its result was printed. He entered on his professorship in the autumn of 1741, on which occasion he pronounced a Latin oration "On the necessity of travelling one's own country." His own past exertions in this respect rendered it a very entertaining and interesting composition. In the same year he made the tour of the islands of Oeland and Gothland, by order of the States; and in subsequent years he travelled, by the same requisition, through West Gothland and Scania. Exclusive of these exertions his abode was henceforth fixed at Upsal, and the remaining history of his life is only that of his literary and scientific labours, and of the honours and distinctions which were accumulated upon him.

One of his first cares was to improve and new model the academic garden. He procured the erection of several new buildings, arranged the plants according to his own system, and founded a museum of natural history in part of the green-house. In 1745 he published the first edition of his "Flora Suecica," an admirable specimen of a local catalogue, and the pattern of all those which have since been made upon the Linnæan system. In the next year appeared his "Fauna Suecica," or Catalogue of the Animal Kingdom in Sweden, arranged also according to his own method. In the numerous and difficult class of insects he adopted an entirely new method of arrangement, which has been adopted by most later entomologists. His merits, indeed, with respect to this class of natural productions, stands next to those with respect to the vegetable productions. The same accurate inspection was requisite in both, and from the immense number of subjects in each, it was equally necessary in both to search out for minute diversities

whereon to found an artificial classification. The credit he was now acquiring in his own country appeared in his election to the post of Secretary to the Academy of Sciences at Upsal; in a medal of him struck at the expence of some noblemen in 1746, and in his nomination by the king to the rank and title of archiater, in 1747. He now also began to exert his influence in procuring the mission of his young disciples to different parts of the globe, in order to make discoveries in natural history and œconomy; a circumstance by which he is distinguished above all other naturalists, and which has redounded equally to his own glory, and to the public advantage. The travels of Kalm, of Osbeck, of Hasselquist, of Lofling, were the fruits of his zeal in this point. To Linnæus may also be ascribed that curious collection of treatises, which, under the name of "Amænitates Academicæ," began to be published in the year 1749, and were continued to a number of volumes. They are academical theses held under Linnæus in his professional capacity, and may be regarded as containing his own doctrines and opinions on most of the points discussed.

The work of Linnæus, which Haller terms his "Maximus Opus et Æternum," appeared in 1753. It was the "Species Plantarum," in two volumes, 8vo. containing a description of every known plant, arranged according to his sexual system. The description, however, is independent of any system, as being founded on the essential character of each species, with a further reference to the generic description given in the "Genera Plantarum." In this publication Linnæus first introduced his admirable invention of trivial names, or epithets taken from the most prominent specific mark of the subject, or from some other characteristic circumstance. The specific descriptions are given in the precise form of a definition, with a great variety of terms of his own invention, simple and compound, forming, as it were, a new botanical language. If in these terms he has not aimed at a classical purity, he has in general formed them upon correct analogy; and it cannot be denied that they are excellently adapted for their purpose. In the same year he was created by the king a Knight of the Polar Star, an honour which had never before been conferred on a literary character. His elevation to the rank of nobility, by the king's sign manual, took place eight years after, in 1761, but antedated 1757, and from that time he wrote his name C. Von Linné. In the mean time honours of a literary kind had been accumulating upon him from foreign countries. Besides many learned societies of inferior rank, he was aggregated to the Imperial Academy, to the Societies of Berlin, London, and to the Academy, and finally was nominated one of the eight foreign members of the Academy of Sciences of Paris, being the first Swede that had obtained that distinction. The remote city of Upsal was visited by many strangers, attracted by his reputation, which extended throughout Europe, and the number of students in its university was doubled. His correspondence included almost all the eminent cultivators of natural history; and he was continually receiving from all parts tributes of books, plants, and specimens which enabled him to complete his vast plan of carrying a new systematic arrangement through every department of nature. This he effected by the completion of his great work, "Systema Naturæ," which had grown in successive editions from a few tables to two, and finally, to three volumes, and received his finishing hand in 1768. In this performance Linnæus is the methodiser, and the nomenclator of all the known productions of the three kingdoms of nature. His classifications are all so far artificial, that he constitutes divisions and subdivisions from minute qualities in the subject, which serve very well as external marks, but frequently have little relation to its essential character, and therefore bring together things in their nature very dissimilar. They are framed, however, with wonderful ingenuity, and have undoubtedly produced a more accurate indentification in all the branches of natural history than before prevailed. This is the first step to an exact history of any subject, and it is ignorance that treats it with contempt as a mere nomenclature. Although arrangement was the point at which Linnæus peculiarly laboured, yet many of his smaller works prove his great attention to matters of use and curiosity; and no school has contributed so much to a thorough knowledge of the productions of nature as the Linnæan. With regard to the particular parts of his system, the botanical was the most generally received, and bids the fairest for duration. The entomological, though possessing great excellence, has in some measure been abrogated by the more comprehensive but more difficult method of Fabricius. Those in the other branches of zoology are gene-

rally in use, but have been improved or rivalled. The mineralogical has been entirely set aside by the great advances made in chemical knowledge. Linnæus also carried his methodising plants into the science of medicine, and published a classified "Materia Medica," and a system of nosology, under the title of "Genera Morborum." Neither of these, however, are considered as happy efforts, and he can scarcely rank among the improvers of his proper profession, except as having brought into notice some popular remedies, and recorded some curious dietetical observations.

A moderate degree of opulence (considerable indeed relatively to the country in which he lived) attended the honour and reputation which Linnæus enjoyed. He was enabled to purchase an estate and villa at Hammerby, near Upsal, which was his chief summer residence during the last fifteen years of his life. Here he had a museum of natural history, on which he gave lectures; and here he occasionally entertained his friends, but with that œconomy which had become a habit with him, and which the possession of wealth, as is frequently the case, rather straightened than relaxed. His vigour and activity continued to an advanced period, though his memory, overburthened with such an immense load of names, began to fail after his sixtieth year. An attack of apoplexy, in May 1774, obliged him to relinquish the most laborious parts of his professional duties, and to close his literary toils. In 1776 a second seisure rendered him paralytic on the right side, and reduced him to a deplorable state of mental and bodily debility. An ulceration of the bladder was the concluding symptom which carried him off, on January 10, 1778, in the seventy-first year of his age. A general mourning took place at Upsal, at his death, and his body was attended to the grave with every token of respect. His memory received distinguished honours, not only in his own country, but from the friends of science in various foreign nations.

Linnæus was below the middle stature, but strong and muscular. His features were agreeable, and his eyes were uncommonly animated. His temper was lively, ardent, irritable; his indignation warm, and his industry indefatigable. He had a large share of natural eloquence, and a good command of language, though his perpetual study of things did not permit him to pay much attention to the ornaments of words. In society he was easy and pleasant; in his domestic relations kind and affectionate, and in the ordinary commerce of life upright and honourable. His views of nature impressed him with the most devout sentiments towards its author, and a glow of unaffected piety is continually breaking forth throughout his writings. If it be generally true that men of real merit are modest estimators of themselves, he was an exception to the rule; for vanity was his greatest foible, and no panegyrist could surpass what he has written to his own praise in his diary. He was, however, totally free from envy, and bestowed applause liberally where it was deserved; nor did his love of fame cause him to descend to personal controversies with antagonists. He left a son and four daughters. The former was joint professor of botany with his father, and succeeded to his medical chair: he was well acquainted with botanical science, but had none of his father's genius. The eldest daughter, Elizabeth-Christiana, had a turn for observation, and became known by her discovery of the luminous quality of the flower tropœolum, communicated to the academy at Stockholm.

Of the numerous works of Linnæus, and their different editions, particular catalogues are given in the works from which this article is composed. Stover's Life of Linnæus. Pulteney's General View of the Writing's of Linnæus, second edition, by Dr. Maton, with the Diary of Linnæus, by himself.

LINNET. See LINARIA.

LINOCIERA, in botany, so named from Geofroy Linocier, Physician at Tournon, in the Vivarais, a genus of the Diandria Monogynia class and order. Essential character: calyx four-toothed; corolla four-petalled; anthers connecting two opposite petals at the base; berry two-celled.

LINSEED, the seed of the plant linum.

LINSPINS, in the military art, small pins of iron which keep the wheel of a cannon, or waggon, on the axletree; for when the end of the axletree is put through the nave, the linspin is put in to keep the wheel from falling off.

LINSTOCK, in the military art, a wooden staff, about three feet long, upon one end of which is a piece of iron which divides in two, turning from one another, having each a place to receive a match, and a screw to keep it fast: the other end is pointed, and shod with iron, to stick in the

ground. It is used by gunners to fire the guns.

LINT, *linum*, from the flax of which linen is made.

In surgery, the term lint denotes the scrapings of linen which is used in dressing wounds, and is made up in various forms, as tents, dossils, pledgets, &c. See SURGERY.

LINUM, in botany, *flax*, a genus of the Pentandria Pentagynia class and order. Natural order of Gruinales. Caryophylleæ, Jussieu. Gerania, Smith. Essential character: calyx five-leaved; petals five; capsule ten-valved, ten celled; seeds solitary. There are twenty-five species. The several species of flax are mostly herbaceous, some are fruticose, or woody at bottom; two are shrubby, and one arboreous; leaves generally alternate; flowers solitary and axillary; corolla commonly blue, sometimes fading to white, and in some yellow. Flax is found wild in many parts of Europe, in corn fields; in England it is, perhaps, doubtful whether it be aboriginal. It is common in the western counties, not only in corn-fields, but in pastures and on downs.

LION. See FELIS.

LIONCELLES, in heraldry, a term used for several lions borne in the same coat of arms.

LIP, *hare*, a disorder in which the upper lip is in a manner slit or divided, so as to resemble the upper lip of a hare, whence the name.

LIPARIA, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: calyx five-cleft, with the lowest segment elongated; corolla wings two-lobed below; stamina the larger, with three shorter teeth; legume ovate. There are five species, natives of the Cape of Good Hope.

LIPPIA, in botany, so named from Augustine Lippi, a genus of the Didynamia Gymnospermia class and order. Natural order of Stellatæ. Vitices, Jussieu. Essential character: calyx four-toothed, roundish, upright, compressed, membranaceous; capsule one-celled, two-valved, two-seeded, straight; seed one, two-celled. There are five species.

LIQUID. Fluids have been divided into two classes; *viz.* those which are elastic, and the non elastic, or those which do not sensibly diminish in bulk when subjected to pressure. The first class are airs or gases, the second liquids: hence we may define a liquid to be a fluid not sensibly elastic, the parts of which yield to the smallest impression, and move on each other. When liquid bodies are mixed together, they act in various ways according to the nature of the substances employed. Some dissolve each other in any proportion, as in the case with most gases when mixed; some unite in determinate proportions; some do not act sensibly upon each other, separating again, though mixed ever so carefully; and some decompose each other.

LIQUIDAMBER, in botany, a genus of the Monoecia Polyandria class and order. Natural order of Coniferæ. Amentaceæ, Jussieu. Essential character: male, calyx common, four-leaved; corolla none; filaments numerous: female, calyx in a globe, four-leaved; corolla none; styles two; capsules many in a globe, two-valved, many-seeded. There are two species, *viz.* L. styraciflua, maple-leaved liquidamber, or sweet gum; and L. imberbe, oriental liquidamber; the trunk of the former is usually two feet in diameter, straight, and free from branches, to the height of fifteen feet; whence the branches spread and rise in a conic form forty feet from the ground. The leaves are shaped like those of the lesser maple, of a dark green colour, their upper surfaces shining; a sweet glutinous substance exudes through their pores in warm weather, which renders them clammy to the touch; in February, before the leaves are formed, the blossoms break forth from the tops of the branches into spikes of yellowish red pappose globular flowers which swell gradually, retaining their round form to the full maturity of their seed vessels, which are thick set with pointed hollow protuberances, and splitting open discharge their seeds. The wood of this tree is good timber, and is used in wainscotting, &c.; the grain is fine, some of it is beautifully variegated. When wrought too green it is apt to shrink. From between the wood and the bark issues a fragrant gum, which trickles from the wounded trees, and by the heat of the sun congeals into transparent drops, which the Indians chew as a preservative to their teeth; it smells very much like Balsam of Tolu, so that it is difficult to distinguish them. The bark is of singular use to the Indians for covering their huts. Native of North America.

LIQUOR *of flints*. Alkalies have a powerful action on silica: they combine in different proportions: two or three parts of

potash, with one of silica, give a compound, which is deliquescent in the air, and soluble in water: this was formerly distinguished by the name of liquor of flints, but it is now denominated silicated alkali.

LIQUORICE. The glycirrhiza, or common liquorice shrub, has a long, thick, creeping root, striking several feet deep into the ground; an upright, firm, herbaceous, annual stalk, three or four feet high, garnished with winged leaves, of four or five pair of oval lobes, terminated by an odd one: and from the axillas, erect spikes of pale blue flowers in July, succeeded by short smooth pods. The root of this plant is the useful part, being replete with a sweet, balsamic, pectoral juice, which is either extracted, or the wood sold in substance. It is much used in all compositions for coughs, and disorders of the stomach; but by far the greatest quantity is used by brewers. The common liquorice is cultivated in most countries of Europe, for the sake of its root; but in Spain and Italy, and particularly in Sicily and Calabria, it makes a considerable article of commerce with this country. In Calabria, liquorice is chiefly manufactured, and exported from Corigliano, Rossano, Cassano, and Palermo. The Calabrian liquorice, upon the whole, is preferable to that coming from Sicily, and the Italian paste to that coming from Spain. Liquorice also grows in great abundance in the Levant; and vast quantities of it are consumed there, in making a decoction which is drank cold in the summer, in the manner of sherbet.

To prepare liquorice, the roots are boiled a long time in water, till the fluid has got a deep yellow tincture; and the water at length evaporated till the remains acquire a consistency, when they are formed into sticks, which are packed up with bay leaves, in the same order as we receive them. The boiling requires the utmost care and precaution, as the juice takes an unpleasant smell and flavour, if burnt in the least degree.

LIRIODENDRUM, in botany, a genus of the Polyandria Polygynia class and order. Natural order of Coadunatæ. Magnoliæ, Jussieu. Essential character: calyx three-leaved; petals six; seeds imbricated into a strobile. There are two species, *viz.* L. tulipifera, common tulip tree; and L. lillifera; the former is a native of North America, where it is a tree of the first magnitude, and is generally known in all the English settlements by the name of poplar. The young shoots of this tree are covered with a smooth purplish bark; they are garnished with large leaves, whose footstalks are four inches long; the leaves are of a singular form, being divided into three lobes; the middle lobe is blunt and hollowed at the point, appearing as if it had been cut with scissars; the upper surface of the leaves is smooth, and of a lucid green, the under of a pale green; the flowers are produced at the end of the branches, composed of six petals, three without and three within, forming a sort of bell-shaped flower, whence the inhabitants of North America gave it the name of tulip; the petals are marked with green, yellow, and red spots, making a beautiful appearance when the trees are charged with flowers; when the flowers fall off the germ swells, and forms a kind of cone, which does not ripen in England; the handsomest tree of this kind, near London, is in a garden at Waltham Abbey.

The wood is used for canoes, bowls, dishes, spoons, and all sorts of joiners' work.

Kalm speaks of having seen a barn of considerable size, the sides and roof of which were made of a single tulip-tree split into boards; there is no wood that contracts and expands so much as this, which is a great inconvenience attending it; the bark is divisible into thin laminæ, which are tough like bast.

LISIANTHUS, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Rotaceæ. Gentianæ, Jussieu. Essential character: calyx keeled; corolla with a ventricose tube, and recurved divisions; stigma two-plated; capsule two-celled, two-valved; the margins of the valves intorted. There are nine species, natives of Jamaica.

LISTING. Persons listed are to be carried within four days, but not sooner than twenty-four hours, after they have enlisted, before the next justice of peace of any county, riding, city, or place, or chief magistrate of any city or town corporate (not being an officer in the army); and if, before such justice or magistrate they dissent from such listing, and return the listing money, and also twenty shillings in lieu of all charges expended on them, they are to be discharged. But such persons refusing or neglecting to return and pay such money within twenty-four hours, shall be deemed as duly listed as if they had assented thereto before the proper magistrate; and they

will, in that case, be obliged to take the oath, or upon refusal they shall be confined by the officer who listed them till they do take it. Persons owning before the proper magistrate, that they voluntarily listed themselves, are obliged to take the oath, or suffer confinement by the officer who listed them till they do take it. The magistrate is obliged, in both cases, to certify that such persons are duly listed; setting forth their birth, age, and calling, if known; and that the second and sixth sections of the articles of war, against mutiny and desertion, were read to them, and that they had taken the oath. Officers offending herein are to be cashiered, and displaced from their office; to be disabled from holding any post, civil or military; and to forfeit 100*l.* Persons receiving inlisting money from any officer, knowing him to be such, and afterwards absconding, and refusing to go before a magistrate to declare their assent or dissent, are deemed to be inlisted to all intents and purposes, and may be proceeded against as if they had taken the oath.

LITA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Rotaceæ. Gentianæ. Jussieu. Essential character: calyx five-cleft, with two or three scales at the base; corolla salver-shaped, with a long tube, dilated at the base and throat; border five-cleft; anthers twin, inserted in the throat; capsule one-celled, two-valved; seeds numerous. There are two species, viz. L. rosea, and L. cærulea, natives of Guiana.

LITANY, a solemn form of supplication to God, in which the priest utters some things fit to be prayed for, and the people join in their intercession, saying, "We beseech Thee to hear us, good Lord," &c.

At first, the use of litanies was not fixed to any stated time, but were only employed as exigencies required. They were observed, in imitation of the Ninevites, with ardent supplications and fastings, to avert the threatening judgments of fire, earthquakes, inundations, or hostile invasions. About the year 400, litanies began to be used in processions, the people walking barefoot, and repeating them with great devotion; and it is pretended, that by this means, several countries were delivered from great calamities. The days on which these were used were called rogation days: these were appointed by the canons of different councils, till it was decreed by the council of Toledo, that they should be used every month throughout the year; and thus by degrees they came to be used weekly on Wednesdays and Fridays, the ancient stationary days for fasting. To these days the rubric of our church has added Sundays, as being the greatest days for assembling at divine service. Before the last review of the "Common Prayer," the litany was a distinct service by itself, and used sometime after the morning prayer was over; at present it is made one office with the morning service, being ordered to be read after the third collect for grace, instead of the intercessional prayers in the daily service.

LITERARY *property*. Authors, it should seem had, by the common law, the sole and exclusive copyright remaining in themselves or their assigns in perpetuity, after having printed and published their compositions. This, as a common law right, was strangely questioned by some of our judges, who studied special pleading more than common sense. But by statute 8 Anne, c. 19, it is secured to them for fourteen years, from the day of publishing; and after the end of fourteen years, the sole right of printing or disposing of copies, shall return to the authors, if then living, for other fourteen years. This statute, it has been held, restrains the right of the author and his assigns to the fourteen or the twenty-eight years, whatever it might have been at the common law. A penalty on each sheet found in the possession of a party pirating a work, is inflicted by the statute, 9 Anne, c. 19; and, in order to entitle the plaintiff to recover this penalty, the book must have been entered at Stationers' Hall. But an author whose work has been pirated, may maintain an action for damages merely without having so entered his book. When an author transfers all his right or interest in a publication to another, and happens to survive the first fourteen years, the second term will result to his assignee, and not to himself. By statute 12 Geo. II. c. 36. 34 Geo. III. c. 20, s. 57, books printed in England originally, may not be reprinted abroad, and imported within twenty years. A last act extends also to Ireland, where English books were frequently pirated. By statute 8 Geo. II. c. 13; 7 Geo. III. c. 28; 17 Geo. III. c. 57. Engravers have a property in their prints and engravings for twenty-eight years absolutely. A fair abridgment is equally protected with an original work. Acting a play on a stage is not a publishing within the statute, 8 Anne, c. 19; but one cannot take a piece in short hand and print it before the author has published it.

LITHARGE, in the arts. Lead is easily

oxydable. When first fused its surface is perfectly bright, but by the contact of the air it is quickly covered with a thick film, called the dross of lead. If this be taken off, the same circumstances again take place, and thus the whole of the lead may be converted into a kind of grey powder, which is the oxide of lead. By exposing it to a higher degree of heat, it acquires a yellow colour, forming a pigment named "massicot:" and by a still greater heat, and causing the flame to play upon the surface, while the powder is constantly stirred, the yellow colour becomes red, and the substance is then called minium, or red lead, which is the metal in a high degree of oxydizement. By a particular management of the heat, during the oxydizement of lead, supplying it quickly with a current of air blown over the surface of the metal, the oxide is semi-vitrified, forming the soft flaky substance named litharge. By a stronger heat, the lead may be vitrified, when it forms the glass of lead.

LITHOMARGE, in mineralogy, is a species of the clay genus, and divided by Werner and others into two sub-species, viz. the friable and the indurated. Friable lithomarge or rock-marrow is white and massive; it occurs likewise as a crust, and disseminated. Its lustre is feebly glimmering, is generally coherent, feels greasy, and adheres to the tongue. It is found in large quantities in the Saxon tin veins. Indurated lithomarge is commonly white, but with many varieties of colour. The white and red are uniform, but the other colours are usually disposed in clouded and spotted delineations. It is found in many parts of Germany, and occurs in veins of porphyry, gneiss and serpentine; in drusy cavities of topaz rock, or nidular in basalt, amygdaloid and serpentine; and imbeds over coal. According to Jameson, the terra-miraculosa, which is remarkable for the beauty of its coloured delineations, is a variety of the indurated lithomarge.

LITHOPHILA, in botany, a genus of the Diandria Monogynia class and order. Essential character: calyx three-leaved; corolla three-petalled; nectary two-leaved. There is only one species, a native of Navaza.

LITHOSPERMUM, in botany, *gromwell*, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: calyx five parted; corolla funnel form, perforated at the throat. There are twelve species, natives of most parts of Europe, particularly in corn-fields and waste places, flowering from May to July.

LITHOTOMY, in surgery, the operation by which a calculus is removed from the bladder.

LITMUS, in chemistry, a substance, the tincture of which is extremely useful, as a test of the presence of an acid or alkali. All acids, and salts, with an excess of acid, change the natural violet purple of litmus to red; when reddened by an acid, the blue is restored by an alkali.

LITTORELLA, in botany, *plaintain shoreweed*, a genus of the Monoecia Tetrandria class and order. Natural order of Plantagines, Jussieu. Essential character: male, calyx four-leaved; corolla four-cleft; stamina long: female, calyx none; corolla slightly, four-cleft; styles long; seed a nut.

LITURGY, a name given to those set forms of prayer which have been generally used in the Christian church. Of these there are not a few ascribed to the apostles and fathers, but they are almost universally allowed to be spurious.

LIVER, in anatomy, a very large viscus, of a red colour, situated in the right hypochondrium, and serving for the secretion of the bile or gall. See ANATOMY; PHYSIOLOGY.

LIVER, a name formerly given to different chemical combinations, because they were supposed to resemble the animal liver in colour only. Thus we had liver of sulphur, liver of antimony, &c. &c. See SULPHURET.

LIVERY *of seisin*, a delivery of possession of lands, tenements, or other corporeal thing (for of things incorporeal there can be no seisin) to one that has right.

Livery of seisin must be on the land in the presence of two witnesses, and was anciently used to give publicity to gifts or transfers of land. It is now necessary, in order to complete a feoffment, and to make good a lease for life or grant of the freehold to commence at a future day. See ESTATE, LEASE. Where there is land and a house, it must be made in the house, that being the principal.

LIVERYMEN, of London, are a number of men chosen from among the freemen of each company. Out of this body the common council, sheriff, and other superior officers for the government of the city are elected, and they alone have the privilege of giving their votes for members of parliament; from which the rest of the citizens are excluded.

LIZARD. See LACERTA.

LOAM, in mineralogy, is a sub-species of the clay genus, and of a yellowish grey colour, frequently spotted yellow and brown. It occurs massive, is dull and sometimes weakly glimmering. It adheres pretty strongly to the tongue, feels greasy, and is not very heavy: it is generally mixed with sand and gravel, and also iron ochre. According to Mr. Jameson it may be considered as sandy potter's clay, mixed with mica and iron ochre. See CLAY.

LOAN, in finance, money borrowed by government for defraying the extraordinary expences of the state.

The comparative advantage or disadvantage of the terms, on which the public loans have been obtained at different periods, has frequently been misrepresented, either from misconception or for party purposes, though it is evidently a subject on which the truth is very easily ascertained. The economy or extravagance of every transaction of this kind depends on its correspondence or disagreement with the price of the public funds, and the current rate of interest at which money could be obtained on good security at the time the bargain was concluded; and, consequently, a loan, on which the highest interest is paid, may have been obtained on the best terms that could be made at the time it was negociated. The interest paid, however, forms the real burthen of each loan to the country; for, since the mode of buying up stock at the market price has been adopted in the redemption of the debt, the nominal capital that is created has become but of little importance, though certainly not to be wholly disregarded.

The first loans differed materially from those of subsequent periods, in being raised wholly on terminable annuities; and in having a particular fund assigned for each loan, by the supposed adequateness or insufficiency of which the interest required by the lenders was frequently influenced, as well as by other causes, which have since ceased to exist.

During the reign of Queen Anne, loans were chiefly raised on annuities for 99 years, till 1711; when, by the establishment of the South Sea Company, a variety of debts were consolidated and made a permanent capital, bearing 6 per cent. interest. About this period lotteries were also frequently adopted for raising money for the public service, under which form a considerable premium was given, in addition to a high rate of interest. This mode of raising money was followed in 1712, 1713, and 1714. In the latter year, though the interest paid was equal to only 5*l.* 7*s.* 2*d.* per cent. on the sum borrowed, the premium allowed was upwards of 34*l.* per cent.; but, as peace was restored, and the legal rate of interest had been reduced to 5 per cent. it seems that a larger premium was allowed, for the sake of appearing to borrow at a moderate rate of interest.

In the reign of George I. the interest on a considerable part of the public debts was reduced to 5 per cent. and the few loans that were raised were, comparatively, of small amount; that of the year 1720, was obtained at little more than 4 per cent. interest.

About 1730 the current rate of interest was 3½ per cent.; and, in 1736, government was enabled to borrow at 3 per cent. per annum. The extraordinary sums necessary for defraying the expenses of the war, which began in 1739, were at first obtained from the sinking fund and the salt-duties; a payment from the Bank, in 1742, rendered only a small loan necessary in that year, which was obtained at little more than 3 per cent. interest. In the succeeding years the following sums were raised by loans.

	Sum borrowed.	Interest.		
	£.	£.	s.	d.
1743	1,800,000	3	8	4
1744	1,800,000	3	6	10
1745	2,000,000	4	0	7
1746	2,500,000	5	5	1
1747	4,000,000	4	8	0
1748	6,300,000	4	8	0

Loans of the seven years' war.

1756	2,000,000	3	12	0
1757	3,000,000	3	14	3
1758	5,000,000	3	6	5
1759	6,600,000	3	10	9
1760	8,000,000	3	13	7
1761	12,000,000	4	1	11
1762	12,000,000	4	10	9
1763	3,500,000	4	4	2

Loans of the American war.

1776	2,000,000	3	9	8
1777	5,000,000	4	5	2
1778	6,000,000	4	18	7
1779	7,000,000	5	18	10
1780	12,000,000	5	16	8
1781	12,000,000	5	11	1
1782	13,500,000	5	18	1
1783	12,000,000	4	13	9
1784	6,000,000	5	6	11

Loans of the war with the French Republic.

	Sum borrowed. £.	Interest. £.	s.	d.
1793	4,500,000	4	3	4
1794	11,000,000	4	10	9
1795	18,000,000	4	15	8
1796	18,000,000	4	14	9
1796	7,500,000	4	12	2
1797	18,000,000	5	14	1
1797	14,500,000	6	6	10
1798	17,000,000	6	4	9
1799	3,000,000	5	12	5
1799	15,500,000	5	5	0
1800	20,500,000	4	14	2
1801	28,000,000	5	5	5

The sums borrowed since the commencement of the war, which began in 1803, have hitherto been of somewhat less extent, as it has been deemed necessary to endeavour to raise a considerable part of the extraordinary sums wanted within the year.

LOASA, in botany, a genus of the Polyandria Monogynia class and order. Essential character: calyx five-leaved, superior; corolla five petalled; petals hooded; nectary five-leaved, converging; capsule turbinate, one celled, three valved, many seeded. There is only one species, viz. L. hispida, a native of South America.

LOBARIA, in natural history, a genus of the Vermes Mollusca class and order. Body above convex, beneath flat lobate. There is but a single species, viz. L. quadriloba, which inhabits the northern seas. It has a tail with four lobes.

LOBE, in anatomy, any fleshy protuberant part, as the lobes of the lungs, lobes of the ears, &c.

LOBELIA, in botany, so named from Matthias de Lobel, a Flemish botanist, a genus of the Syngenesia Monogamia class and order. Natural order of Campanaceæ. Campanulaceæ, Jussieu. Essential character: calyx five-cleft; corolla one petalled, irregular; capsule inferior, two or three-celled. There are forty-two species; these are mostly herbaceous plants, some annual, more perennial, and a few suffruticose, or woody at the bottom of the stems, which in some are prostrate, in others upright; leaves alternate; flowers either solitary and axillary with two small bractes, or in loose terminating spikes with three little bractes. The predominant colour of the corollas is blue; they are chiefly natives of the Cape of Good Hope.

LOCAL *action*, is an action restrained to the proper county, in opposition to a transitory action, which may be laid in any county at the plaintiff's discretion. In local actions, where possession of land is to be recovered, or damages for an actual trespass, or for waste, or the like, affecting land, the plaintiff must lay his declaration, or declare his injury to have happened in the very county and place that it really did happen in; but in transitory actions, for injuries that may happen any where, as debt, detinue, slander, and the like, the plaintiff may declare in what county he pleases, and then the trial must be in that county in which the declaration is laid; though if the defendant will make affidavit that the cause of action, if any, arose not in that, but in another county, the court will oblige the plaintiff to declare in the proper county.

LOCAL *problem*, among mathematicians, such a one as is capable of an infinite number of different solutions, by reason that the point which is to resolve the problem may be indifferently taken within a certain extent, as suppose any where, within such a line, within such a plane, figure, &c. which is called a geometric locus, and the problem is said to be a local or indetermined one. See Locus.

A local problem may be either simple, when the point sought is in a right line; plane, when the point sought is in the circumference of a circle; solid, when the point required is in the circumference of a conic section; or lastly, sursolid, when the point is in the perimeter of a line of the second gender, or of an higher kind, as geometers call it.

LOCK, an instrument used for fastening doors, chests, &c. generally opened by a key. The lock is esteemed the masterpiece in smithery; much art and delicacy being required in contriving and varying the wards, bolts, and springs. From the different structure of locks, accommodated to their different use, they acquire different names: thus those placed on outer doors are called stock-locks; those on inner doors, spring-locks; those on trunks, trunk-locks, pad-locks, &c. Of these the spring-lock is the most curious: its principal parts are, the main-plate, the cover-plate, and the pin hole: to the main-plate belong the key-hole, top-hook, cross-wards, bolt-toe, or bolt-nab, drawback-spring, tumbler, pin of the tumbler, and the staples; to the cover-plate belong the pin, main-ward, cross-ward, step-ward, or dapper-ward; to the pin-hole belong the hook-ward, main cross-

ward, shank, the pot or bread, bit, and bow-ward.' The importation of locks is prohibited.

LOCK, or WEIR, in inland navigations, the general name for all those works of wood or stone, made to confine and raise the water of a river; the banks, also, which are made to divert the course of a river, are called by these names in some places. But the term lock is more particularly appropriated to express a kind of canal inclosed between two gates; the upper called by workmen the sluice-gate, and the lower called the flood-gate. These serve in artificial navigations to confine the water, and render the passage of boats easy in passing up and down the stream. See CANAL.

LOCUS *geometricus*, denotes a line, by which a local or indeterminate problem is solved. See LOCAL PROBLEM.

A locus is a line, any point of which may equally solve an indeterminate problem. Thus, if a right line suffice for the construction of the equation, it is called *locus ad rectum*; if a circle, *locus ad circulum*; if a parabola, *locus ad parabolam*; if an ellipsis, *locus ad ellipsin*; and so of the rest of the conic sections.

The loci of such equations as are right lines, or circles, the ancients called *plain loci*; and of those that are parabolas, hyperbolas, &c. *solid loci*. But Wolfius, and others, among the moderns, divide the loci more commodiously into orders, according to the numbers of dimensions to which the indeterminate quantities rise. Thus, it will be a locus of the first order, if the equation is $x = \frac{a y}{c}$; a locus of the second or quadratic order, if $y^2 = a x$, or $y^2 = a^2 - x^2$; a locus of the third or cubic order, if $y^3 = a^2 x$, or $y^3 = a x^2 - x^3$, &c.

The better to conceive the nature of the locus, suppose two unknown and variable right lines A P, P M (Plate VIII. Miscel. fig. 4 and 5) making any given angle A P M with each other; the one whereof, as A P, we call x, having a fixed origin in the point A, and extending itself indefinitely along a right line given in position; the other P M, which we call y, continually changing its position, but always parallel to itself. An equation only containing these two unknown quantities, x and y, mixed with known ones, which expresses the relation of every variable quantity A P, (x), to its correspondent variable quantity P M, (y): the line passing through the extremities of all the values of y, *i. e.* through all the points M, is called a *geometrical locus*, in general, and the locus of that equation in particular.

All equations, whose loci are of the first order, may be reduced to some one of the four following formulas; 1. $y = \frac{b x}{a}$. 2. $y = \frac{b x}{a} + c$. 3. $y = \frac{b x}{a} - c$. 4. $y = c - \frac{b x}{a}$. Where the unknown quantity, y, is supposed always to be freed from fractions, and the fraction that multiplies the other unknown quantity x, to be reduced to this expression $\frac{b}{a}$, and all the known terms to c.

The locus of the first formula being already determined: to find that of the second, $y = \frac{b x}{a} + c$; in the line A P, fig. 6, take A B $= a$, and draw B E $= b$, A D $= c$ and parallel to P M. On the same side A P, draw the line A E of an indefinite length towards E, and the indefinite straight line D M parallel to A E. Then the line D M is the locus of the aforesaid equation, or formula; for if the line M P be drawn from any point M thereof parallel to A Q, the triangles A B E, and A P F, will be similar: and therefore A B (a) : B E (b) :: A P (x) P F $= \frac{b x}{a}$; and consequently P M (y) $=$ P F $\left(= \frac{b x}{a}\right) +$ F M (c).

To find the locus of the third form, $y = \frac{b x}{a} - c$, proceed thus: assume A B $= a$ (fig. 7); and draw the right lines B E $= b$, A D $= c$ and parallel to P M, the one on one side A P, and the other on the other side: and through the points A E, draw the line A E of an indefinite length towards E, and through the point D, the line D M parallel to A E: then the indefinite right line G M shall be the locus sought; for we shall have always P M $= (y) =$ P F $= \left(\frac{b x}{a}\right) -$ F M (c).

Lastly, to find the locus of the fourth formula, $y = c - \frac{b x}{a}$; in A P (fig. 8): take A B $= a$, and draw B E $= b$, A D $= c$, and parallel to P M, the one on one side A P, and the other on the other side; and through the points A, and E, draw the line A E indefinitely towards E, and through the point D draw the line D M parallel to A E. Then D G shall be the locus sought; for if the line M P be drawn from any point

M thereof, parallel to A Q, then we shall always have P M = F M — P F, that is $y = c - \frac{bx}{a}$.

Hence it appears, that all the loci of the first degree are straight lines; which may be easily found, because all their equations may be reduced to some one of the foregoing formulas.

All loci of the second degree are conic sections, viz. either the parabola, the circle, ellipsis, or hyperbola: if an equation therefore be given, whose locus is of the second degree, and it be required to draw the conic section, which is the locus thereof; first draw a parabola, ellipsis, or hyperbola; so as that the equations expressing the natures thereof may be as compound as possible. In order to get general equations, or formulas, by examining the peculiar properties whereof we may know which of these formulas the given equation ought to have regard to; that is, which of the conic sections will be the locus of the proposed equation. This known, compare all the terms of the proposed equation with the terms of the general formula of that conic section, which you have found will be the locus of the given equation; by which means you will find how to draw the section, which is the locus of the equation given.

For example; let A P = x, P M = y, be unknown, and variable straight lines (fig. 9); and let m, n, p, r, s, be given right lines: in the line A P take A B = m, and draw B E = n, A D = r and parallel to P M; and through the point A draw A E = e, and through the point D the indefinite right line D G parallel to A E. In D G take D C = s, and with C G, as a diameter, having its ordinates parallel to P M, and the line C H = p, as the parameter, describe a parabola C M: then the portion thereof, included in the angle P A D, will be the locus of the following general formula:

$$yy - \frac{2nxy}{m} + \frac{nnxx}{mm} - 2ry + \frac{2nrx}{m} + rr - \frac{epx}{m} + ps. = o.$$

For if from any point M of that portion there be drawn the right line M P, making any angle A P M with M P; the triangles A B E, A P F, shall be similar; therefore, A B : A E :: A P : A F or D G; that is, $m : e :: x : \frac{ex}{m}$. And A B : B E :: A P : P F; that is, $m : n :: x : \frac{nx}{m}$. And consequently, G M or P M — P F — F G = $y - \frac{nx}{m} - r$. And C G or D G — D C = $\frac{ex}{m} - s$. But from the nature of the parabola G M^2 = C G × C H; which equation will become that of the general formula, by putting the literal values of those lines.

Again, if through the fixed point A you draw the indefinite right line A Q (fig. 10), parallel to P M, and you take A B = m, and draw B E = n and parallel to A P, and through the determinate points A E, the line A E = e; and if in A P you take A D = r: and draw the indefinite straight line D G parallel to A E, and take D C = s: this being done, if with the diameter C G, whose ordinates are parallel to A P, and parameter the line C H = p, you describe a parabola C M; the portion of this parabola contained in the angle B A P shall be the locus of this second equation, or formula:

$$xx - \frac{2nyx}{m} + \frac{nnyy}{mm} - 2rx + \frac{2nry}{m} + rr - \frac{epy}{m} + ps. = o.$$

For, if the line M Q be drawn from any point M, therein, parallel to A P; then will, A B : A E :: A Q or P M : A F or D G; that is, $m : e :: y : \frac{ey}{m}$; and A B : B E :: A Q : Q F; that is, $m : n :: y : \frac{ny}{m}$. And therefore G M or Q M — Q F — F G = $x - \frac{ny}{m} - r$; and C G or D G — D C = $\frac{ey}{m} - s$.

And so by the common property of the parabola, you will have the foregoing second equation, or formula. So likewise may be found general equations for the other conic sections.

Now if it be required to draw the parabola, which we find to be the locus of this proposed equation $yy - 2ay - bx + cc = o$; compare every term of the first formula with the terms of the equation, because yy in both is without fractions; and then will $\frac{2n}{m} = o$, because the rectangle xy not being in the proposed equation, the said rectangle may be esteemed as multiplied by o; whence $n = o$, and $m = e$; because the line A E falling in A B, that is, in A P in the construction of the formula, the points B E, do coincide. Therefore destroying all the terms adfected with $\frac{n}{m}$

in the formula, and substituting n for e, we shall get $yy - 2ry - px + rr + ps = o$. Again, by comparing the correspondent terms $-2ry$ and $-2ay$, as also $-px$ and $-bx$, we have $r = a$, and $p = b$; and comparing the terms wherein are neither of the unknown quantities $x\,y$, we get $rr + ps = cc$; and substituting a and b for r and p, then will $s = \frac{cc - aa}{b}$, which is a negative expression when a is greater than c, as is here supposed. There is no need of comparing the first terms yy and yy, because they are the same. Now the values of n, r, p, s, being thus found, the sought locus may be constructed by means of the construction of the formula, and after the following manner.

Because $BE = n = o$ (fig. 11), the points B E, do coincide, and the line A E falls in A P; therefore through the fixed point A draw the line $AD = r = a$ parallel to P M, and draw D G parallel to A P, in which take $DC = \frac{aa - cc}{b} = -s$; then with D C, as a diameter, whose ordinates are right lines parallel to P M, and parameter the line $CH = p = b$, describe a parabola: then the two portions O M M, R M S, contained in the angle P A O, formed by the line A P, and the line A O drawn parallel to P M, will be the locus of the given equation, as is easily proved.

If in a given equation whose locus is a parabola, xx is without a fraction; then the term of the second formula must be compared with those of the given equation.

Thus much for the method of constructing the loci of the equations which are conic sections. If, now, an equation whose locus is a conic section, be given, and the particular section whereof it is the locus be required: all the terms of the given equation being brought over to one side, so that the other be equal to nothing, there will be two cases.

Case I. When the rectangle xy is not in the given equation. 1. If either yy or xx be in the same equation, the locus will be a parabola. 2. If both xx and yy are in the equation with the same signs, the locus will be an ellipsis, or a circle. 3. If xx and yy have different signs, the locus will be an hyperbola, or the opposite sections regarding their diameters.

Case II. When the rectangle xy is in the given equation. 1. If neither of the squares xx or yy, or only one of them, be in the same, the locus of it will be an hyperbola between the asymptotes. 2. If yy and xx be therein, having different signs, the locus will be an hyperbola regarding its diameters. 3. If both the squares xx and yy are in the equation, having the same signs, you must free the square yy from fractions; and then the locus will be an hyperbola, when the square of $\frac{1}{2}$ the fraction multiplying xy, is equal to the fraction multiplying xx, an ellipsis, or circle, when the same is less; and an hyperbola, or the opposite sections, regarding their diameters, when greater.

LOCUST. See GRYLLUS.

LODGMENT, in military affairs, is a work raised with earth, gabions, fascines, wool-packs, or mantelets, to cover the besiegers from the enemy's fire, and to prevent their losing a place which they have gained, and are resolved, if possible, to keep. For this purpose, when a lodgment is to be made on the glacis, covert-way, or in a breach, there must be great provision made of fascines, sand-bags, &c. in the trenches; and during the action, the pioneers with fascines, sand-bags, &c. should be making the lodgment, in order to form a covering in as advantageous a manner as possible from the opposite bastion, or the place most to be feared.

LOEFLINGIA, in botany, so called from Peter Loefling; a genus of the Triandria Monogynia class and order. Natural order of Caryophyllei. Essential character: calyx five-leaved; corolla five-petalled, very small; capsule one-celled, three valved. There is but one species, viz. L. hispanica, a native of Spain.

LOESELIA, in botany, from Joseph Loesel, a genus of the Didynamia Angiospermia class and order. Natural order of Convolvuli, Jussieu. Essential character: calyx four-cleft; corolla with all the segments directed one way; stamina opposite to the petal; capsule three-celled. There is but one species, viz. L. ciliata, found at La Vera Cruz in South America.

LOG, in naval affairs, a machine used to measure the rate of a ship's velocity through the water. For this purpose, there are several various inventions, but the one most generally used is the following, called the common log. It is a piece of thin board, forming the quadrant of a circle of about six inches radius, and balanced by a small plate of lead nailed on the circular part, so as to swim perpendicular in the water, with the greater part immersed. The log-line is

fastened to the log, by means of two legs, one of which is knotted through a hole at one corner, while the other is attached to a pin fixed in a hole at the other corner, so as to draw out occasionally. The log-line being divided into certain spaces (which are in proportion to an equal number of geographical miles, as a half, or quarter minute, is to an hour of time), is wound about a reel. The whole is employed to measure the ship's head-way in the following manner: the reel being held by one man, and the half minute-glass by another, the mate of the watch fixes the pin, and throws the log over the stern, which swimming perpendicularly, feels an immediate resistance, and is considered as fixed, the line being slackened over the stern to prevent the pin coming out. The knots are measured from a mark on the line, at the distance of twelve or fifteen fathoms from the log; the glass is therefore turned at the instant that the mark passes over the stern; and as soon as the sand in the glass has run out, the line is stopped; the water then being on the log dislodges the pin, so that the board now presenting only its edge to the water is easily drawn aboard. The number of knots and fathoms which had run off at the expiration of the glass determines the ship's velocity. The half minute glass and divisions on the line should be frequently measured to determine any variation in either of them, and to make allowance accordingly. If the glass runs thirty seconds, the distance between the knots should be fifty feet. When it runs more or less, it should, therefore, be corrected by the following analogy. As thirty is to fifty, so is the number of seconds of the glass to the distance between the knots upon the line. As the heat or moisture of the weather has often a considerable effect on the glass, so as to make it run slower or faster, it should be frequently tried by the vibrations of a pendulum. As many accidents attend a ship during a day's sailing, such as the variableness of wind, the different quantity of sail carried, &c. it will be necessary to heave the log at every alteration; but if none of these alterations be perceptible, yet it ought to be constantly heaved. In ships of war and East Indiamen, it is usual to heave the log once every hour, and in all other vessels once in two hours; and if at any time of the watch the wind has increased or abated in the intervals, so as to affect the ship's velocity, the officer generally makes a suitable allowance for it at the close of the watch.

Log *board*, a table generally divided into five columns, in the first of which is entered the hour of the day; in the second, the course steered; in the third, the number of knots run off the reel each time of heaving the log; in the fourth, from what point the wind blows; and in the fifth, observations on the weather, variation of the compass, &c.

Log *book*, a book ruled in columns like the log-board, into which the account on the log-board is transcribed every day at noon; from whence, after it is corrected, &c. it is entered into the journal.

Log *wood*, in the arts, is derived from a low prickly tree, which is found in great plenty at Campeachy, in the bay of Honduras, and is denominated "hæmatoxylon campechianum." It comes to Europe in large logs, cleared from the bark, and is very hard, compact, heavy, and of a red colour. It is in high request among dyers, especially in dying black. It gives out the colour both to water and alcohol; the liquor at first assumes a fine red colour with a shade of purple. The infusion becomes gradually deeper, and at last almost black. To cloth previously boiled in alum and tartar, it gives a beautiful violet colour, which, however, will not stand. Alkalies render the colour darker, acids change it to yellow. From a variety of experiments it is found that the colouring matter of log-wood bears in many respects a strong analogy to tannin, but in others it differs from it.

LOGARITHMIC, in general, something belonging to logarithms. See Logarithms.

Logarithmic *curve*. If on the line A N (Plate VIII. Miscel. fig. 12) both ways indefinitely extended, be taken, A C, C E, E G, G I, I L, on the right hand. And also A *g*, *g* P, &c. on the left, all equal to one another. And, if at the points P, *g*, A, C, E, G, I, L, be erected to the right line, AN, the perpendiculars P S, *g d*, A B, C D, E F, G H, I K, L M, which let be continually proportional, and represent numbers, *viz.* A B, 1, C D, 10, E F, 100, &c. then shall we have two progressions of lines, arithmetical and geometrical: for the lines A C, A E, A G, &c. are in arithmetical progression, or as 1, 2, 3, 4, 5, &c. and so represent the logarithms to which the geometrical lines A B, C D, E F, &c. do correspond. For since A G is triple of the right line A C, the number G H shall be in the third place from unity, if C D be in the first: so, likewise shall L M be in the fifth place, since A L = 5 A C. If the extremities of the proportionals S *d*,

B, D, F, &c. be joined by right lines, the figure S B M L will become a polygon, consisting of more or less sides, according as there is more or less terms in the progression.

If the parts A C, C E, E G, &c. be bisected in the points *c*, *e*, *g*, *i*, *l*, and there be again raised the perpendiculars *c d*, *e f*, *g h*, *i k*, *l m*, which are mean proportionals between A B, C D; C D, E F, &c. then there will arise a new series of proportionals, whose terms beginning from that which immediately follows unity, are double of those in the first series, and the difference of the terms are become less, and approach nearer to a ratio of equality than before. Likewise, in this new series, the right lines A L, A *c*, express the distances of the terms L M, *c d*, from unity; *viz.* since A L is ten times greater than A *c*, L M shall be the tenth term of the series from unity; and, because A *e* is three times greater than A *c*, *e f* will be the third term of the series if *c d* be the first, and there shall be two mean proportionals between A B and *e f*; and between A B and L M there will be nine mean proportionals. And if the extremities of the lines B *d*, D *f*, F *h*, &c. be joined by right lines, there will be a new polygon made, consisting of more but shorter sides than the last.

If, in this manner, mean proportionals be continually placed between every two terms, the number of terms at last will be made so great, as also the number of the sides of the polygon, as to be greater than any given number, or to be infinite; and every side of the polygon so lessened, as to become less than any given right line; and consequently the polygon will be changed into a curve-lined figure; for any curve-lined figure may be conceived as a polygon, whose sides are infinitely small and infinite in number. A curve described after this manner, is called logarithmical.

It is manifest from this description of the logarithmic curve, that all numbers at equal distances are continually proportional. It is also plain, that if there be four numbers, A B, C D, I K, L M, such that the distance between the first and second be equal to the distance between the third and the fourth; let the distance from the second to the third be what it will, these numbers will be proportional. For because the distances A C, I L, are equal, A B shall be to the increment D *s*, as I K is to the increment M T. Wherefore, by composition, A B : D C : : I K : M L. And, contrarywise, if four numbers be proportional, the distance between the first and second shall be equal to the distance between the third and fourth.

The distance between any two numbers, is called the logarithm of the ratio of those numbers; and, indeed, doth not measure the ratio itself, but the number of terms in a given series of geometrical proportionals, proceeding from one number to another, and defines the number of equal ratios by the composition whereof the ratio of numbers are known.

LOGARITHMS, are the indexes or exponents (mostly whole numbers and decimal fractions, consisting of seven places of figures at least) of the powers or roots (chiefly broken) of a given number; yet such indexes or exponents, that the several powers or roots they express, are the natural numbers 1, 2, 3, 4, 5, &c. to 10 or 100000, &c. (as if the given number be 10, and its index be assumed 1.0000000, then the 0.0000000 root of 10, which is 1, will be the logarithm of 1; the 0.301036 root of 10, which is 2, will be the logarithm of 2; the 0.477121 root of 10 which is 3, will be the logarithm of 3; the 0.612060 root of 10, the logarithm of 4; the 1.041393 power of 10 the logarithm of 11; the 1.079181 power of 10 the logarithm of 12, &c.) being chiefly contrived for ease and expedition in performing of arithmetical operations in large numbers, and in trigonometrical calculations; but they have likewise been found of extensive service in the higher geometry, particularly in the method of fluxions. They are generally founded on this consideration, that if there be any row of geometrical proportional numbers, as 1, 2, 4, 8, 16, 32, 64, 128, 256, &c. or 1, 10, 100, 1000, 10000, &c. And as many arithmetical progressional numbers adapted to them, or set over them, beginning with 0.

$$\text{thus, }\left\{\begin{array}{llllllll} 0, & 1, & 2, & 3, & 4, & 5, & 6, & 7, \ \&c. \\ 1, & 2, & 4, & 8, & 16, & 32, & 64, & 128, \ \&c. \end{array}\right\}$$

$$\text{or, }\left\{\begin{array}{llllll} 0, & 1, & 2, & 3, & 4, & \&c. \\ 1, & 10, & 100, & 1000, & 10000, & \&c. \end{array}\right\}$$

Then will the sum of any two of these arithmetical progressionals, added together, be that arithmetical progressional which answers to, or stands over the geometrical progressional, which is the product of the two geometrical progressionals over which the two assumed arithmetical progressionals stand: again, if those arithmetical progressionals be subtracted from each other, the remainder will be the arithmetical progressional standing over that geometrical progressional which is the quotient of the

division of the two geometrical progressionals belonging to the two first assumed arithmetical progressionals; and the double, triple, &c. of any one of the arithmetical progressionals will be the arithmetical progressional standing over the square, cube, &c. of that geometrical progression which the assumed arithmetical progressional stands over, as well as the one-half, one-third, &c. of that arithmetical progressional, will be the geometrical progressional answering to the square root, cube root, &c. of the arithmetical progressional over it; and from hence arises the following common, though imperfect definition of logarithms; viz.

That they are so many arithmetical progressionals, answering to the same number of geometrical ones. Whereas, if any one looks into the tables of logarithms, he will find, that these do not all run on in an arithmetical progression, nor the numbers they answer to in a geometrical one; these last being themselves arithmetical progressionals. Dr. Wallis, in his history of algebra, calls logarithms, the indexes of the ratios of numbers to one another. Dr. Halley, in the Philosophical Transactions, Number 216, says, they are the exponents of the ratios of unity to numbers. So, also Mr. Cotes, in his "Harmonia Mensurarum," says, they are the numerical measures of ratios: but all these definitions convey but a very confused notion of logarithms. Mr. Maclaurin, in his "Treatise of Fluxions," has explained the natural and genesis of logarithms, agreeably to the notion of their first inventor, Lord Neper. Logarithms then, and the quantities to which they correspond, may be supposed to be generated by the motion of a point: and if this point moves over equal spaces in equal times, the line described by it increases equally.

Again, a line decreases proportionably, when the point that moves over it describes such parts in equal times as are always in the same constant ratio to the lines from which they are subducted, or to the distances of that point, at the beginning of those lines, from a given term in that line. In like manner, a line may increase proportionably, if in equal times the moving point describes spaces proportional to its distances from a certain term at the beginning of each time. Thus, in the first case, let *a c* (Plate IX. Miscel. fig. 1 and 2.) be to *a o*, *c d* to *c o*, *d e* to *d o*, *e f* to *e o*, *f g* to *f o*, always in the same ratio of Q R to Q S; and suppose the point P sets out from *a*, describing *a c*, *c d*, *d e*, *e f*, *f g*, in equal parts of the time; and let the space described by P in any given time, be always in the same ratio to the distance of P from *o* at the beginning of that time, then will the right line *a o* decrease proportionally.

In like manner, the line *o a* (fig. 3.) increases proportionally, if the point *p*, in equal times, describes spaces *a c*, *c d*, *d e*, *e f*, *f g*, &c. so that *a c* is to *a o*, *c d* to *c o*, *d e* to *d o*, &c. in a constant ratio. If we now suppose a point P describing the line A G (fig. 4) with an uniform motion, while the point *p* describes a line increasing or decreasing proportionally, the line A P, described by P, with this uniform motion, in the same time that *o a*, by increasing or decreasing proportionally, becomes equal to *o p*, is the logarithm of *o p*. Thus A C, A D, A E, &c. are the logarithms of *o c*, *o d*, *o e*, &c. respectively; and *o a* is the quantity whose logarithm is supposed equal to nothing.

We have here abstracted from numbers, that the doctrine may be the more general; but it is plain, that if A C, A D, A E, &c. be supposed, 1, 2, 3, &c. in arithmetic progression; *o c*, *o d*, *o e*, &c. will be in geometric progression; and that the logarithm of *o a*, which may be taken for unity, is nothing.

Lord Neper, in his first scheme of logarithms, supposes, that while *o p* increases or decreases proportionally, the uniform motion of the point P, by which the logarithm of *o p* is generated, is equal to the velocity of *p* at *a*; that is, at the term of time when the logarithms begin to be generated. Hence logarithms, formed after this model, are called Neper's Logarithms, and sometimes Natural Logarithms.

When a ratio is given, the point *p* describes the difference of the terms of the ratio in the same time. When a ratio is duplicate of another ratio, the point *p* describes the difference of the terms in a double time. When a ratio is triplicate of another, it describes the difference of the terms in a triple time; and so on. Also, when a ratio is compounded of two or more ratios, the point *p* describes the difference of the terms of that ratio in a time equal to the sum of the times, in which it describes the difference of the terms of the simple ratios of which it is compounded. And what is here said of the times of the motion of *p* when *o p* increases proportionally, is to be applied to the spaces

described by P, in those times, with its uniform motion.

Hence the chief properties of logarithms are deduced. They are the measures of ratios. The excess of the logarithm of the antecedent above the logarithm of the consequent, measures the ratio of those terms. The measure of the ratio of a greater quantity to a lesser is positive; as this ratio, compounded with any other ratio, increases it. The ratio of equality, compounded with any other ratio, neither increases nor diminishes it; and its measure is nothing. The measure of the ratio of a lesser quantity to a greater is negative; as this ratio, compounded with any other ratio, diminishes it. The ratio of any quantity A to unity, compounded with the ratio of unity to A, produces the ratio of A to A, or the ratio of equality; and the measures of those two ratios destroy each other when added together; so that when the one is considered as positive, the other is to be considered as negative. By supposing the logarithms of quantities greater than *o a* (which is supposed to represent unity) to be positive, and the logarithms of quantities less than it to be negative, the same rules serve for the operations by logarithms, whether the quantities be greater or less than *o a*. When *o p* increases proportionally, the motion of *p* is perpetually accelerated; for the spaces *a c*, *c d*, *d e*, &c. that are described by it in any equal times that continually succeed after each other, perpetually increase in the same proportion as the lines *o a*, *o c*, *o d*, &c. When the point *p* moves from *a* towards *o*, and *o p* decreases proportionally, the motion of *p* is perpetually retarded; for the spaces described by it in any equal times that continually succeed after each other, decrease in this case in the same proportion as *o p* decreases.

If the velocity of the point *p* be always as the distance *o p*, then will this line increase or decrease in the manner supposed by Lord Neper; and the velocity of the point *p* being the fluxion of the line *o p*, will always vary in the same ratio as this quantity itself. This, we presume will give a clear idea of the genesis, or nature of logarithms; but for more of this doctrine, see Maclaurin's Fluxions.

LOGARITHMS, *construction of*. The first makers of logarithms, had in this a very laborious and difficult task to perform; they first made choice of their scale or system of logarithms, that is, what set of arithmetical progressionals should answer to such a set of geometrical ones, for this is entirely arbitrary; and they chose the decuple geometrical progressionals, 1, 10, 100, 1000, 10000, &c. and the arithmetical one, 0, 1, 2, 3, 4, &c. or, 0.000000; 1.000000; 2.000000; 3.000000; 4.000000, &c. as the most convenient. After this they were to get the logarithms of all the intermediate numbers between 1 and 10, 10 and 100, 100 and 1000, 1000 and 10000, &c. But first of all they were to get the logarithms of the prime numbers 3, 5, 7, 11, 13, 17, 19, 23, &c. and when these were once had, it was easy to get those of the compound numbers made up of the prime ones, by the addition or subtraction of their logarithms.

In order to this, they found a mean proportion between 1 and 10, and its logarithm will be one-half that of 10; and so given, then they found a mean proportional between the number first found and unity, which mean will be nearer to 1 than that before, and its logarithm will be one half of the former logarithm, of one-fourth of that of 10; and having in this manner continually found a mean proportional between 1 and the last mean, and bisected the logarithms, they at length, after finding 54 such means, came to a number
1.0000000000000001278191493200323442, so near to 1 as not to differ from it so much as $\frac{1}{10000000000000000}$ part, and found its logarithm to be
0.000000000000000055511151231257827 02
and
0000000000000001278191493200323 5 to be the difference whereby 1 exceeds the number of roots or mean proportionals found by extraction; and then, by means of these numbers, they found the logarithms of any other numbers whatsoever; and that after the following manner: between a given number, whose logarithm is wanted, and 1, they found a mean proportional, as above, until at length a number (mixed) be found, such a small matter above 1, as to have 1 and 15 cyphers after it, which are followed by the same number of significant figures; then they said, as the last number mentioned above, is to the mean proportional thus found, so is the logarithm above, viz. 0.00000000000000005551115123125782702 to the logarithm of the mean proportional number, such a small matter exceeding 1, as but now mentioned; and this logarithm being as often doubled as the number of mean proportionals, (formed to get that number) will be the logarithm of the given

number. And this was the method Mr. Briggs took to make the logarithms. But if they are to be made to only seven places of figures which are enough for common use, they had only occasion to find 25 mean proportionals, or, which is the same thing, to extract the $\frac{1}{33554432}$th root of 10. Now having the logarithms of 3, 5, and 7, they easily got those of 2, 4, 6, 8, and 9; for since $\frac{10}{5} = 2$, the logarithm of 2 will be the difference of the logarithms of 10 and 5; the logarithm of 4 will be two times the logarithm of 2; the logarithm of 6 will be the sum of the logarithm of 2 and 3; and the logarithm of 9 double the logarithm of 3. So, also having found the logarithms of 13, 17, and 19, and also of 23 and 29, they did easily get those of all the numbers between 0 and 30, by addition and subtraction only; and so having found the logarithms of other prime numbers, they got those of other numbers compounded of them.

But since the way above hinted at, for finding the logarithms of the prime numbers is so intolerably laborious and troublesome, the more skilful mathematicians that came after the first inventors, employing their thoughts about abbreviating this method, had a vastly more easy and short way offered to them from the contemplation and mensuration of hyperbolic spaces contained between the portions of an asymptote, right lines perpendicular to it, and the curve of the hyperbola: for if E C N (Plate IX. fig. 5) be an hyperbola, and A D, A Q, the asymptotes, and A B, A P, A Q, &c. taken upon one of them, be represented by numbers, and the ordinates B C, P M, Q N, &c. be drawn from the several points B, P, Q, &c. to the curve, then will the quadrilinear spaces B C M P, P M N Q, &c. viz. their numerical measures be the logarithms of the quotients of the division of A B by A P, A P by A Q, &c. since when A B, A P, A Q, &c. are continual proportionals, the said spaces are equal, as is demonstrated by several writers concerning conic sections. See HYPERBOLA.

Having said that these hyperbolic spaces, numerically expressed, may be taken for logarithms, we shall next give a specimen, from the said great Sir Isaac Newton, of the method how to measure these spaces, and consequently of the construction of logarithms.

Let C A (fig. 6) = A F be $= 1$, and A B $=$ A $b = x$; then will $\frac{1}{1+x}$ be $=$ B D, and $\frac{1}{1-x} = bd$; and putting these expressions into series, it will be $\frac{1}{1+x} = 1 - x + x^2 - x^3 + x^4 - x^5$, &c. and $\frac{1}{1-x} = 1 + x + x^2 + x^3 + x^4 + x^5$, &c. and $\frac{\dot{x}}{1+x} = \dot{x} - x\dot{x} + x^2\dot{x} - x^3\dot{x} + x^4\dot{x} - x^5\dot{x}$ &c. and $\frac{\dot{x}}{1-x} = \dot{x} + x\dot{x} + x^2\dot{x} + x^3\dot{x} + x^4\dot{x} + x^5\dot{x}$, &c. and taking the fluents, we shall have the area A F D B $= x - \frac{xx}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5}$, &c. and the area A F $d\,b$, $= x + \frac{xx}{2} + \frac{x^3}{3} + \frac{x^4}{4} + \frac{x^5}{5}$ &c. and the sum $b\,d$ D B $= 2x + \frac{2x^3}{3} + \frac{2}{5}x^5 + \frac{2}{7}x^7 + \frac{2}{9}x^9$, &c. Now if A B, or $a\,b$, be $\frac{1}{10} = x$, C b being $=$ 0.9, and C B $=$ 1.1, by putting this value of x in the equations above, we shall have the area $b\,d$ D B $=$ 0.2006706954621511 for the terms of the series will stand as you see in this table,

	Term of the series.
0.2000000000000000	= first
6666666666666	= second
40000000000	= third
285714286	= fourth
2222222	= fifth
18182	= sixth
154	= seventh
1	= eighth
0.2006706954621511	

If the parts A d and A D of this area be added separately, and the lesser D A be taken from the greater d A, we shall have A d — A D $= x^2 + \frac{x^4}{2} + \frac{x^6}{3} + \frac{x^8}{4}$, &c. $=$ 0.0100503358535014, for the terms reduced to decimals will stand thus:

	Term of the series.
0.0100000000000000	= first
500000000000	= second
3333333333	= third
25000000	= fourth
200000	= fifth
1667	= sixth
14	= seventh
0.0100503358535014	

Now if this difference of the areas be added to, and subtracted from their sum before found, half the aggregate, viz. 0.1053605156578263 will be the greater area A d, and half the remainder, viz.

0.0953101798043249, will be the lesser area A D.

By the same tables, these areas A D and A d, will be obtained also when A B + A b are supposed to be $\frac{1}{100}$ or C B = 1.01, and C b = 0.99, if the numbers are but duly transferred to lower places, as

	Term of the series.
0.0200000000000000 =	first
6666666666 =	second
400000 =	third
28 =	fourth
Sum = 0.0200006667066694 =	area b D.

	Term of the series.
0.0001000000000000 =	first
50000000 =	second
3333 =	third
0.0001000050003333 =	area A d — A D.

Half the aggregate 0.0100503358535014 = A d, and half the remainder, viz. 0.0099503308531681 = A D.

And so putting A B = A b = $\frac{1}{1000}$, or C B = 1.001 and C b = 0.999, there will be obtained A d = 0.0010005000333583, and A D = 0.0009995001333083.

After the same manner, if A B = A b, be = 0.2, or 0.02, or 0.002, these areas will arise.

A d = 0.2231435513142097, and
A D = 0.1823215576939546, or
A d = 0.0202027073175194, and
A D = 0.1098026272961797, or
A d = 0.002002, and A D = 0.001.

From these areas, thus found, others may be easily had from addition and subtraction only. For since $\frac{1.2}{0.8} + \frac{1.2}{0.9} = 2$, the sum of the arcs belonging to the ratios $\frac{1.2}{0.8}$ and $\frac{1.2}{0.9}$ (that is, insisting upon the parts of the absciss 1.2, 0.8; and 1.2, 0.9), viz.

0.405465, &c. and $\left\{ \begin{array}{l} \text{A D} = 0.18232, \text{\&c.} \\ \text{A } d = 0.10536, \text{\&c.} \end{array} \right.$

Sum = 0.28768, &c.

added thus, $\left\{ \begin{array}{l} 0.40546, \text{\&c.} \\ 0.28768, \text{\&c.} \end{array} \right.$

Total = 0.69314, &c. = the area of A F H G, when C G is — 2. Also since $\frac{1.2}{0.8} + 2 = 3$, the sum 1.0986122, &c. of the areas belonging to $\frac{1.2}{0.8}$ and 2, will be the area of A F G H, when C G = 3. Again, since $\frac{2 \times 2}{0.8} = 5$, and $2 \times 5 = 10$; by adding A d = 0.2231, &c. A D = 0.1823, &c. and A d = 0.1053, &c. together, their sum is 0.5108, &c. and this added to 1.0986, &c. the area of A F G H, when C G = 3. You will have 1.6093379124341004 = A F G H, when C G is 5; and adding that of 2 to this, gives 2.3025850929940457 = A F G H, when C G is equal to 10: and since $10 \times 10 = 100$; and $10 \times 100 = 1000$; and $\sqrt{5 \times 10 \times 0.98} = 7$, and $10 \times 1.1 = 11$, and $\frac{1000 \times 1.091}{7 \times 11} = 13$, and $\frac{1000 \times 0.998}{2} = 499$; it is plain that the area A F G H may be found by the composition of the areas found before, when C G = 100, 1000, or any other of the numbers above-mentioned; and all these areas are the hyperbolic logarithms of those several numbers.

Having thus obtained the hyperbolic logarithms of the numbers 10, 0.98, 0.99, 1.01, 1.02; if the logarithms of the four last of them be divided by the hyperbolic logarithm 2.3025850, &c. of 10, and the index 2, be added; or, which is the same thing, if it be multiplied by its reciprocal 0.4342944819032518, the value of the subtangent of the logarithmic curve, to which Briggs's logarithms are adapted, we shall have the true tabular logarithms of 98, 99, 100, 101, 102. These are to be interpolated by ten intervals, and then we shall have the logarithms of all the numbers between 980 and 1020; and all between 980 and 1000, being again interpolated by ten intervals, the table will be as it were constructed. Then from these we are to get the logarithms of all the prime numbers, and their multiples less than 100, which may be done by addition and subtraction only: for $\frac{\sqrt[10]{84 \times 1020}}{9945} = 2$; $\frac{\sqrt[4]{8 \times 9963}}{984} = 3$; $\frac{10}{2} = 5$; $\frac{\sqrt{98}}{2} = 7$; $\frac{99}{9} = 11$; $\frac{1001}{7 \times 11} = 13$; $\frac{102}{6} = 17$; $\frac{998}{4 \times 13} = 19$; $\frac{9936}{16 \times 27} = 23$; $\frac{986}{2 \times 17} = 29$; $\frac{992}{32} = 31$; $\frac{999}{27} = 37$; $\frac{984}{24} = 41$; $\frac{989}{23} = 43$; $\frac{987}{21} = 47$; $\frac{9911}{11 \times 17} = 53$; $\frac{9971}{13 \times 13} = 59$; $\frac{9882}{2 \times 81} = 61$; $\frac{9949}{3 \times 49} = 67$; $\frac{994}{14} = 71$; $\frac{9928}{8 \times 17} = 73$; $\frac{9954}{7 \times 18} = 79$; $\frac{996}{12} = 83$; $\frac{9968}{7 \times 16} = 89$; $\frac{9894}{6 \times 17} = 97$; and thus having the logarithms of all the numbers less than 100, you have nothing

to do but interpolate the several times through ten intervals.

Now the void places may be filled up by the following theorem. Let n be a number, whose logarithm is wanted; let x be the difference between that and the two nearest numbers, equally distant on each side, whose logarithms are already found; and let d be half the difference of their logarithms: then the required logarithm of the number n will be had by adding $d+\frac{dx}{2n}+\frac{dx^3}{12n^3}$, &c. to the logarithm of the lesser number: for if the numbers are represented by Cp, CG, CP (fig. 16.) and the ordinates ps, PQ, be raised; if n be wrote for CG, and x for GP, or Gp, the area psQP, or $\frac{2x}{n}+\frac{x^2}{2n^2}+\frac{x^3}{3n^3}$, &c. will be to the area psHG, as the difference between the logarithms of the extreme numbers, or $2d$, is to the difference between the logarithms of the lesser, and of the middle one; which, therefore, will be

$$\frac{\frac{dx}{n}+\frac{dx^2}{2n}+\frac{dx^3}{3n}, \text{ \&c.}}{\frac{x}{n}+\frac{x^3}{3n}+\frac{x^5}{5n}, \text{ \&c.}}=d+\frac{dx}{2n}+\frac{dx^3}{12n^3}, \text{ \&c.}$$

The two first terms $d+\frac{dx}{2n}$ of this series, being sufficient for the construction of a canon of logarithms, even to 14 places of figures, provided the number, whose logarithm is to be found, be less than 1000; which cannot be very troublesome, because x is either 1 or 2: yet it is not necessary to interpolate all the places by help of this rule, since the logarithms of numbers, which are produced by the multiplication or division of the number last found, may be obtained by the numbers whose logarithms were had before, by the addition or subtraction of their logarithms. Moreover, by the difference of their logarithms, and by their second and third differences, if necessary, the void places may be supplied more expeditiously, the rule beforegoing being to be applied only where the continuation of some full places is wanted, in order to obtain these differences.

By the same method rules may be found for the intercalation of logarithms, when of three numbers the logarithm of the lesser and of the middle number are given, or of the middle number and the greater; and this although the numbers should not be in arithmetical progression. Also by pursuing the steps of this method, rules may be easily discovered for the construction of artificial sines and tangents, without the help of the natural tables. Thus far the great Newton, who says, in one of his letters to M. Leibnitz, that he was so much delighted with the construction of logarithms, at his first setting out in those studies, that he was ashamed to tell to how many places of figures he had carried them at that time: and this was before the year 1666; because, he says, the plague made him lay aside those studies, and think of other things.

Dr. Keil, in his Treatise of Logarithms, at the end of his Commandine's Euclid, gives a series, by means of which may be found easily and expeditiously the logarithms of large numbers. Thus, let z be an odd number, whose logarithm is sought: then shall the numbers $z-1$ and $z+1$ be even, and accordingly their logarithms, and the difference of the logarithms will be had, which let be called y. Therefore, also the logarithm of a number, which is a geometrical mean between $z-1$ and $z+1$, will be given, *viz.* equal to half the sum of the logarithms. Now the series $y \times \frac{1}{4z}+\frac{1}{24z^3}+\frac{181}{15120z^7}+\frac{13}{25200z^9}$, &c. shall be equal to the logarithm of the ratio, which the geometrical mean between the numbers $z-1$ and $z+1$, has to the arithmetical mean, *viz.* to the number z. If the number exceeds 1000, the first term of the series, *viz.* $\frac{y}{4z}$, is sufficient for producing the logarithm to 13 or 14 places of figures, and the second term will give the logarithm to 20 places of figures. But if z be greater than 10000, the first term will exhibit the logarithm to 18 places of figures: and so this series is of great use in filling up the chiliads omitted by Mr. Briggs. For example, it is required to find the logarithm of 20001: the logarithm of 20000 is the same as the logarithm of 2, with the index 4 prefixed to it; and the difference of the logarithms of 20000 and 20001, is the same as the difference of the logarithms of the numbers 10000 and 10001, *viz.* 0.0000434272, &c. And if this difference be divided by $4z$, or 80004, the quotient $\frac{y}{4z}$ shall be

0.000000000542813 ; and if the logarithm of the geometrical mean, *viz.* 4.301051709302416 be added to the quotient, the sum will be 4.301051709845230 = the logarithm of 20001.

Wherefore it is manifest that to have the logarithm to 14 places of figures, there is no necessity of continuing out the quotient beyond 6 places of figures. But if you have a mind to have the logarithm to 10 places of figures only, the two first figures are enough. And if the logarithms of the numbers above 20000 are to be found by this way, the labour of doing them will mostly consist in setting down the numbers. This series is easily deduced from the consideration of the hyperbolic spaces aforesaid. The first figure of every logarithm towards the left hand, which is separated from the rest by a point, is called the index of that logarithm; because it points out the highest or remotest place of that number from the place of unity in the infinite scale of proportionals towards the left hand: thus, if the index of the logarithm be 1, it shows that its highest place towards the left hand is the tenth place from unity; and therefore all logarithms which have 1 for their index, will be found between the tenth and hundredth place, in the order of numbers. And for the same reason all logarithms which have 2 for their index, will be found between the hundredth and thousandth place in the order of numbers, &c. Whence universally the index or characteristic of any logarithm is always less by one than the number of figures in whole numbers, which answer to the given logarithm; and, in decimals, the index is negative.

As all systems of logarithms whatever are composed of similar quantities, it will be easy to form, from any system of logarithms, another system in any given ratio; and consequently to reduce one table of logarithms into another of any given form. For as any one logarithm in the given form is to its correspondent logarithm in another form, so is any other logarithm in the given form to its correspondent logarithm in the required form; and hence we may reduce the logarithms of Lord Neper into the form of Briggs's, and contrarywise. For as 2.302585092, &c. Lord Neper's logarithm of 10, is to 1.0000000000, Mr. Briggs's logarithm of 10; so is any other logarithm in Lord Neper's form to the correspondent tabular logarithm in Mr. Briggs's form: and because the two first numbers constantly remain the same; if Lord Neper's logarithm of any one number be divided by 2.302585, &c. or multiplied by .4342944, &c. the ratio of 1.0000, &c. to 2.30258, &c. as is found by dividing 1.00000, &c. by 2.30258, &c. the quotient in the former, and the product in the latter, will give the correspondent logarithm in Briggs's form, and the contrary. And, after the same manner, the ratio of natural logarithms to that of Briggs's will be found = 868588963806.

The use and application of LOGARITHMS. It is evident, from what has been said of the construction of logarithms, that addition of logarithms must be the same thing as multiplication in common arithmetic; and subtraction in logarithms the same as division: therefore, in multiplication by logarithms, add the logarithms of the multiplicand and multiplier together, their sum is the logarithm of the product.

		num.	logarithms.
Example.	Multiplicand..	8.5	0.9294189
	Multiplier.....	10	1.0000000
	Product.......	85	1.9294189

And in division, subtract the logarithm of the divisor from the logarithm of the dividend, the remainder is the logarithm of the quotient.

		num.	logarithms.
Example.	Dividend..	9712.8	3.9873444
	Divisor....	456	2.6589648
	Quotient..	21.3	1.3283796

LOGARITHM, *to find the complement of a.* Begin at the left hand, and write down what each figure wants of 9, only what the last significant figure wants of 10; so the complement of the logarithm of 456, *viz.* 2.6589648, is 7.3410352.

In the rule of three. Add the logarithms of the second and third terms together, and from the sum subtract the logarithm of the first, the remainder is the logarithm of the fourth. Or, instead of subtracting a logarithm, add its complement, and the result will be the same.

LOGARITHMS, *to raise powers by.* Multiply the logarithm of the number given by the index of the power required, the product will be the logarithm of the power sought.

Example. Let the cube of 32 be required

by logarithms. The logarithm of 32 = 1.5051500, which multiplied by 3, is 4.5154500, the logarithm of 32768, the cube of 32. But in raising powers, *viz.* squaring, cubing, &c. of any decimal fraction by logarithms, it must be observed, that the first significant figure of the power be put so many places below the place of units, as the index of its logarithm wants of 10, 100, &c. multiplied by the index of the power.

LOGARITHMS, *to extract the roots of powers by.* Divide the logarithm of the number by the index of the power, the quotient is the logarithm of the root sought.

To find mean proportionals between any two numbers. Subtract the logarithm of the least term from the logarithm of the greatest, and divide the remainder by a number more by one than the number of means desired; then add the quotient to the logarithm of the least term (or subtract it from the logarithm of the greatest) continually, and it will give the logarithms of all the mean proportionals required.

Example. Let three mean proportionals be sought, between 106 and 100.

Logarithm of 106 =		2.0253059
Logarithm of 100 =		2.0000000
Divide by		4)0.0253059(0.0063264.75
Logarithm of the least term 100 addded		2.0000000
Logarithm of the first mean.......	101.4673846	2.0063264.75
Logarithm of the second mean....	102.9563014	2.0126529.5
Logarithm of the third mean......	104.4670483	2.0189794.25
Logarithm of the greatest term...	106	2.0253059

LOGIC, the art of reasoning. As the necessities of our existence oblige us to think, and to arrange our thoughts in such a manner as may enable us to communicate with each other, we are habitually impelled towards a conclusion that it is unnecessary to teach reasoning as an art. It is hardly needful to combat this notion by arguments which will easily occur to most men of reflection; and indeed the contrary persuasion was so prevalent in the middle ages, that men seem to have been more occupied with the art, than with the proper use of it.

In order to reason well, it is necessary that the nature of our perceptions and ideas, and the notions or conclusions we draw from them, should be well understood. Logic, therefore, is a science of extensive occupation; which has its beginning in the constitution of things, and the processes of the human intellect, and its practical termination in the structure, use, and application of language. Its objects are no less than the universal acquisition of knowledge, and that mutual communication which constitutes a large part of the employment, and is the most distinguishing character of man.

The impressions made by external objects upon the senses, are called sensations or ideas of sensation. See IDEOLOGY. The recollection or remembrance of those sensations are simply called ideas. The general notions which are produced in the mind by reflecting upon ideas, have been called ideas of reflection; but as they all grow out of the comparison of the first-mentioned ideas, and do universally in the last result imply propositions, it appears much preferable to call them notions.

Logical writers divide ideas into simple and complex; but as we have no simple sensations, and can therefore have no simple ideas but by the artificial process of abstraction, the division seems useless. The word complex here signifies compounded, and the compounded nature of our ideas will practically depend, in a great measure, upon our choice or determination in the subject of our reasoning. Thus, a lemon is soft, fragrant, yellow, and acid. If I throw a lemon at another, the attention will be chiefly directed to the organ of touch, and its fragrance, its tint, and its acidity, will be abstracted or left out. But the perfumer, the designer, and the chemist would separately attend to those parts of the idea which were suggested by the organs of smell, of vision, and of taste. And in this manner it is that we may separate the simple ideas of yellowness, acidity, and fragrance; though, in nature, their causes never appear insulated and apart from those of all the other sensations.

Abstraction, or the leaving out parts of ideas or notions; generalization, or classing things together, as possessing the remaining distinctive characters; composition, or the re-assumption of some of the abstracted or

rejected ideas, are the voluntary acts of the mind, adopted in order to facilitate the useful process of Comparison. Thus we may abstract from bodies all ideas but those of structure, and divide them into organized and unorganized; or we may take the organized bodies, and call them animals and vegetables; or we may attend to their place of existence, and call them terrestrial, aquatic, volatile, and the like; and many of our most useful propositions will, thus, in all our mental operations, continue equally general and abstracted.

In the scientific arrangement of natural objects, philosophers have pursued the course of abstraction, until by rejecting all the ideas capable of affording the distinctive characters of individuals, they arrived at an hypothetical being called substance. Much has been written concerning it; but it will perhaps be attended with the least obscurity to say, that it is supposed to be an independent existence which serves as the basis or support to those properties which are perceived by our senses; or, in the words of logicians, it is the subject of modes and accidents.

The modes of substance are those distinguishable objects of sense which might, if separate, produce simple ideas. Thus, softness, fragrance, yellowness, and acidity, are among the modes which co-exist in the subject or substance, lemon. Many distinctions are made in modes. They are called essential or accidental, absolute or relative, &c. The moderns appear to use the words properties of bodies, and powers and laws of nature, with much more distinctness than the earlier logicians did their modes and accidents.

Words are intended to be the signs of things, but are very far from being so. If our ideas were adequate representations of the things which cause them, which they are not; if they were not of necessity mutilated by abstraction, and there were not a continual exertion in language to emulate the rapidity of thought, then might words obtain the supposed resemblance. But the boasted extent and perspicuity of the intellect of man proceeds but a little beyond the signs and tones of those inferior animals who are supposed to have no power of conversing. And even if we could vanquish the insuperable difficulties which impede our clear mutual communication, what are the grounds of our knowledge? they are very limited and often fallacious.

Knowledge consists in the determination of those modes of surrounding beings which are taken to be permanent, and of those which are observed to vary. The former are chiefly of the nature of quantity and position, and the latter seem resolvable into motion. Mathematical science appears to comprehend the whole of the first; and the latter, which embraces by far the greater part of what concerns our existence and well-being, is included in those histories of events upon which we establish our principles of cause and effect. Abstraction, or analysis, can give us very clear notions of the subjects of mathematics; and in these alone it is that we find absolute proof or demonstration. But in all the rest of our knowledge the facts are complex, obscure, and of uncertain evidence; and the principal, nay the only ground, of our reliance upon our doctrines respecting them, is that our predictions are in many instances verified.

Words being constructed and established by mere usage, are not only inadequate and contracted in their use, but equivocal and synonimous; that is to say, one word may be used to denote several distinct and different things; as when we speak of a beam of light, a beam of timber, or the beam of a pair of scales; or, on the contrary, as when we speak of an house, an habitation, or a residence. It must be admitted, however, that there are few synonymes in the practice of those who are masters of a language; because few words are consecrated by usage to precisely the same meaning.

Many acute and useful disquisitions have been written upon language and universal grammar. See Language.

Since our idea of a thing must be composed or made up of all the simple ideas which that thing can produce by our perceptions, and this will for the most part be inadequate; the word, denomination, or name of a thing, must be the sign of that idea, liable to such additional error as may arise from any improper use that may be made of it. And as by abstraction we generalize our ideas and notions, and afterwards comprehend and compare them at our pleasure; so in the construction of language a like order is followed in words. Thus we may arrange things, from their similitude, under classes more or less abstracted as to their modes, calling these classes by the names of genera and species. And in the names of things, we shall have not only to regard this arrangement; but likewise the appropriation and correct use of the denomination itself. If we had terms for all simple

ideas,and were to enumerate in due order all the simple ideas subsisting in a thing, that enumeration would constitute what is called a definition of the thing; and simple ideas would be, as in strictness they are, undefinable. But since all our sensations are complex, the relations of simple ideas with regard to each other, as residing in the same subject, will afford the means of indicating them. Thus, light is that by which the organ of vision is acted upon, and the word is therefore defined or indicated from that organ. Colour is a mode of light perhaps too simple to be defined, but clearly indicable from any natural subject in which it may subsist; as, for example, green is the colour of grass, red is the colour of a rose, and yellow the colour of an orange.

Thus, then, the nature of terms, or words, is fixed by definition; a thing for the most part of extreme difficulty, as, from our ignorance of things, and the complexity of the objects comprehended by usage under any term, it can in few cases be done. The arrangement of things is by genera, where the same class of beings agree in a few attributes only; and by species, where they agree in more; and these genera and species may be subordinate to each other in numerous pairs, the genus immediately above each species being called the proximate genus. And from this ordinary arrangement logicians obtain a ready method of defining from the specific difference, which, though certainly much less adequate than those of the mathematicians, is nevertheless very useful. That is to say, the genus and the specific difference is held to constitute the definition of the species. Thus, if the words, 1. animal; 2. four-footed; 3. graminivorous; and, 4. fleece-bearing, be the arrangement of certain beings possessing life, we should define the first genus from the only character left by the abstraction, namely, that it is a being possessing life; and the first species would be admitted to be well defined by the words four-footed animal (named quadruped); the second, by the words graminivorous quadruped (named cattle); and the third by the words fleece-bearing cattle (named sheep): or we might less conveniently go through the whole series, and call the sheep a fleece-bearing, graminivorous, four-footed animal.

Logicians also avail themselves in defining, where practicable, of some striking attribute called the essence of a thing. Thus, under the genus, measure, the species bushel, peck, quartern, &c. are essentially distinguished by the respective magnitudes which are capable of being numerically expressed.

All our knowledge is contained in propositions, and every proposition consists of three parts. Thus in the proposition, "Snow is white," there are three parts or terms, *snow*, which is called the subject; *is* which is called the copula; and *white*, which is called the predicate. If the proposition agree with the nature of things it is true, if not it is false. All propositions are reducible to this form, though both the subject and predicate may be expressed by many words; but the copula will always be some inflexion of the verb *to be*, with the word *not* if the proposition be negative.

Propositions which contain either a plurality of predicates or of subjects, or which manifest a compounded nature in either, have been called compound propositions. In the first, however, the proposition seems merely to be a number of propositions conjoined, &c.; in the latter, the form of words may be considered as forming a definition of the words or terms. Thus, "John and Thomas departed," includes the propositions, "John was departing, and Thomas was departing." And again the proposition, "Water frozen in flakes as it falls from the atmosphere *is* coloured like the powder of pure dry salt," is evidently the same proposition as was first given, excepting that it contains a definition of the word *snow* taken from its formation, and of the word *whiteness* from a substance of which it is one of the modes.

Our limits will not permit us to enter into the form of propositions from which they are denominated copulative, casual, relative, or disjunctive or modal; as where a proposition itself becomes the subject, or positive, or negative, and so forth. These distinctions are in few cases useful, and in many tedious, trifling, and deceptive.

Truth is determined either intuitively; as when the relation between the predicate and its subject is immediately seen and admitted. So "the whole is equal to all its parts:"—and these simple truths are called axioms:—

Or else it is determined demonstratively; so the proposition, "the opposite angles made by right lines crossing each other are equal," is not intuitive, but requires to be demonstrated by a succession of axioms connected together:

Or lastly it is determined analogically; upon the probability that what has happened will, in like circumstances, happen

again. Thus, upon the probability that bodies will continue to fall to the ground; that violent motion will be followed by heat; that similar inducements or motives will be followed by similar acts in men; we found the doctrine of cause and effect, and establish our knowledge of physical and moral history, so as to give credit to the past, and confidence in many respects to the future.

It is evident that analogical propositions have much less certainty than those of intuition or demonstration.

Though in our investigations of truth we must necessarily have recourse to observations of individual objects and events, as the ground-work of all; yet in our inductions, reasonings, proofs, and processes of instruction, we proceed from generals to individuals. And, as in strict demonstration the subject and predicate of a proposition are connected by a train of axioms,—so in every other argumentation it will be the endeavour of a wise man to follow the same course as nearly as may be possible. But, from the confusion arising from the relations of the complicated objects of social intercourse, and from the rapidity of language with its abridgements and transpositions, so many things are left to be understood—that it is not often an easy task to show, whether the reasoner does really pursue the course of pure argumentation, or whether he deceives himself or others. Logicians have therefore adopted a formal arrangement for each of the steps of comparison which they call a syllogism; not calculated indeed for the discovery of remote truths from the use and application of the more immediate or intuitive, but well calculated to give regularity to the mind by scientific discipline, and to shorten controversy by a clear detection of the component parts of false reasoning. And here, by the way, it may be remarked that the inexplicable disorder of the logical reasonings of the middle ages is less to be attributed to the nature of their science of reasoning, loaded as it was with needless distinctions, than to their theological and psychological dogmas, and the delusions into which they wandered with regard to the objects called transcendental; delusions which a sound and bold application of their own science, if it could have been dared, would not have confirmed, but overthrown.

But to return; the syllogism consists of three propositions. In the first, called the major proposition, something is predicated of a general subject: in the second, called the minor, the subject of the major becomes the predicate of a specific subject: and in the third, called the conclusion, the predicate of the general subject is applied to the specific. Thus,

Major. All men are fallible.
Minor. The Pope is a man;
Conclusion. Therefore the Pope is fallible.

The major and minor terms are often called the premises, and the minor is sometimes called the argument. The premises are supposed to be intuitive, or at least incontestable, and the conclusion is established upon the axiom, that whatever can be predicated or affirmed of a genus, may also be predicated of every species comprehended under it; and the like of species, and the individuals comprehended under them.

It is usual to denominate the two subjects, and the predicate, terms of the syllogism. The generic word or sentence is called the middle term; its predicate is the major term; and the specific word or sentence is called the minor term. Thus, in the preceding syllogism the three terms are

Major term. Fallible.
Middle term. All men.
Minor term. The Pope.

Here it is not pretended, that all men should upon every occasion reason according to the rules of logic, any more than that a writer should upon all occasions insert each individual member of a sentence, and leave nothing to be supplied or understood. But as the man who is a sound grammarian can analyse and parse every member of a sentence, and will write with order, precision, and correctness; so will the logician, who is able to arrange the parts of an argument in mood and figure, be quick in discerning the imperfect, defective, or inadmissible assertions, and will so dispose his own notions and principles, that his proofs shall be conclusive and clear. The works even of mathematical writers would, in many instances, be benefited by this severity of conduct; and there are few indeed which might not be rendered more perfect by strict logical examination and correction.

Mood and figure are words applied by logical writers to denote the arrangement of the terms of a syllogism. It is done by the use of the letters A, E, I, O, of which A denotes universal affirmative; E, universal negative; I, particular affirmative; and O, particular negative. But as it would be difficult to retain in the memory the various

changes in the order of these letters, if prefixed to the three parts of a syllogism, fourteen artificial words have been formed, of three syllables each, containing the vowels so to be prefixed in the order of the mood to be denoted by each word. The fourteen moods are classed under these different figures, by which terms logicians mean to denote the particular situation of the middle term, with respect to the major and minor. The first figure is distinguished by the middle term being the subject of the major, and predicate of the minor proposition, and its four moods are denoted by the words *Barbara*, *Celarent*, *Darii*, *Ferio*. The second figure admits of negative conclusions only, the major being always universal, and one of the premises negative. Its moods are *Cesare*, *Camestres*, *Festino*, *Baroco*. And in the third figure the middle term is the subject of both premises, the minor affirmative, and the conclusion, particular. Its moods are *Darapti*, *Felapton*, *Disamis*, *Datisi*, *Bocardo*, *Ferison*. We shall not extend our article to exemplify these moods, nor shall we proceed to give instances of the form and complexities of syllogisms, which systematic writers have been more solicitous to enumerate and name, than to analyze and develope. In like manner we shall pass over the consideration of the various sophisms treated of by them, because these objects would lead us too far, and their detection follows immediately upon a statement of the premises and conclusions, according to rule. And upon the whole, we shall conclude by observing, that though the old logic was burthensome, from the manner in which it had been suffered to enlarge itself; yet since much of our present modes of reasoning, and of the expressions made use of at the bar, in the senate, and among our best writers, are derived from its rules; and, since the moderns, when they decried and rejected it, have not been solicitous to establish any determinate or correct system, we deem it entitled to more attention than has usually been paid to it.

LOGISTIC *curve*, the same with that otherwise called logarithmic. See LOGARITHMIC.

LOGISTIC *spiral*. See LOGARITHMIC and SPIRAL.

LOGISTICA *numeralis*, the same with algorithm. See ALGORITHM.

LOGISTICAL *arithmetic*, the doctrine of sexagesimal fractions. See SEXAGESIMALS.

LOGOGRAPHY, a method of printing, in which the types, instead of answering only to a single letter, are made to correspond to whole words. The properties of the logographic art are, 1. That the compositor shall have less charged upon his memory, than in the common way. 2. It is much less liable to error. 3. The type of each word is as easily laid hold of as that of a single letter. 4. The decomposition is much more readily performed. 5. No extraordinary expense, nor greater number of types, is required in the logographic, than in the common method of printing.

LOLIUM, in botany, *ray grass*, a genus of the Triandria Digynia class and order. Natural order of Gramineæ, or grasses. Essential character: calyx one-leafed, fixed, many-flowered. There are five species.

LOMENTACEÆ, in botany, the name of the thirty-third order in Linnæus's Fragments of a Natural Method, consisting of plants, many of which furnish beautiful dyes, and the pericarpium of which, universally a leguminous pod, contains seeds that are farinaceous or mealy like those of the bean. The cassia, wild senna; hæmatoxylon, logwood; mimosa, sensitive plant, &c. are of this order.

LOMONITE, in mineralogy, is of a snow white colour, with a slight tendency to reddish white. It occurs massive; the fracture is foliated, and the surface of the folia are streaked, which gives a peculiar glimmering aspect to the surface of the fossil; it is easily frangible, and not heavy: when preserved from the air it has a slight degree of coherence; but if it is exposed to the action of that fluid, the folia spontaneously separate from each other, and it is soon reduced to a heap of unconnected parts. It forms a kind of jelly with acids, and is found in the lead mines of Huelgoet in Lower Brittany. It received its name from Gillet Laumont, who discovered it about twenty years ago.

LONCHITES, in botany, a genus of the Cryptogamia Filices class and order. Natural order of Filices, or ferns. Generic character: capsule disposed in lunulated lines lying under the sinuses of the frond. There are five species, all natives of very hot climates.

LONCHIURUS, in natural history, a genus of fishes of the order Thoracici. Generic character: the head scaly; ventral fins separate; the tail lanceolated. The bearded lonchiurus, the only species belonging to this genus, is a native of Surinam, about twelve inches in length, has a

slightly lengthened nose, two beards at the lower jaw, and the first ray of the ventral fins elongated into a bristle. Its colour is a ferruginous brown.

LONG (ROGER), D. D. Master of Pembroke-hall in Cambridge, Lowndes's professor of astronomy in that university, &c. was author of a well known and much approved treatise of astronomy, and the inventor of a remarkably curious astronomical machine. This was a hollow sphere of 18 feet diameter, in which more than 30 persons might sit conveniently. Withinside the surface, which represented the heavens, was painted the stars and constellations, with the zodiac, meridians, and axis parallel to the axis of the world, upon which it was easily turned round by a winch. He died December 16, 1770, at 91 years of age.

A few years before his death, Mr. Jones gave some anecdotes of Dr. Long, as follows: "He is now in the 88th year of his age, and for his years vegete and active. He was lately put in nomination for the office of vice-chancellor: he executed that trust once before, I think in the year 1737. He is a very ingenious person, and sometimes very facetious. At the public commencement, in the year 1713, Dr. Greene (master of Bennet College, and afterwards Bishop of Ely) being then vice-chancellor, Mr. Long was pitched upon for the tripos performance: it was witty and humorous, and has passed through divers editions. Some that remembered the delivery of it, told me, that in addressing the vice-chancellor, (whom the university wags usually styled Miss Greene) the tripos orator, being a native of Norfolk, and assuming the Norfolk dialect, instead of saying, 'Domine vice-cancellarie,' archly pronounced the words thus, 'Domina vice-cancellaria;' which occasioned a general smile in that great auditory. His friend, the late Mr. Boufoy, of Ripton, told me this little incident: That he and Dr. Long, walking together in Cambridge, in a dusky evening, and coming to a short post fixed in the pavement, which Mr. Boufoy, in the midst of chat and inattention, took to be a boy standing in his way, he said in a hurry, 'Get out of my way, boy.' 'That boy, sir,' said the Doctor, very calmly and slyly, 'is a post-boy, who turns out of his way for nobody.' I could recollect several other ingenious repartees, if there were occasion. One thing is remarkable, he never was a hale and hearty man, always of a tender and delicate constitution, yet took great care of it; his common drink water; he always dines with the fellows in the hall. Of late years he has left off eating flesh-meats; in the room thereof puddings, &c. sometimes a glass or two of wine."

LONGEVITY, the continuance of life beyond its ordinary period of duration. The term of human life does not in general much exceed 80 years, but it is well known that instances occasionally occur of persons living to the age of 100 years and upwards. Such instances however have not excited that general attention, which from the nature of the subject might be expected, and it is only of late years that any extensive collection of them has been formed, or attempts made to ascertain the circumstances and situations in which the different individuals preserved their lives to an age so much beyond the usual lot of man. The most extensive catalogue of this kind, is that published by J. Easton, which, though very defective, contains the names and some particulars of 1712 persons who had attained to a century and upwards, having died at the following ages:

from 100 to 110 years......	1310
110 to 120..............	277
120 to 130....	84
130 to 140........	26
140 to 150....	7
150 to 160	3
160 to 170..............	2
170 to 185.............	3
	1712

The circumstances which chiefly tend to promote longevity may be reduced to the following heads:

1. *Climate.* A large majority of the recorded instances of great age were inhabitants of Great Britain or Ireland, of France, Germany, or the north of Europe, from which it appears that moderate or even cold climates are the most favourable to long life. Heat relaxes and enfeebles, while cold consolidates and strengthens the human frame. The diet also of hot countries is less nourishing than that of cold ones; and there is generally a greater disposition, and greater opportunities to indulge in various excesses in the former, than in the latter. There are however a few instances of natives of very hot climates having attained to great age, but they have been chiefly negroes in the West Indies and America, whose ages were probably not very correctly ascertained.

2. *Parentage.* Being born of healthy parents, and exempted from hereditary disease, are circumstances evidently favourable to the duration of life; and numerous instances warrant the opinion, that longevity prevails in some families more than in others, or that descent from long-lived ancestors is one of the circumstances which give the greatest probability of attaining to extreme old age.

3. *Form and size of the individual.* It is generally admitted, that persons of a compact shape, and of a moderate stature, are the most likely to live long. Tall persons frequently acquire a habit of stooping, which contracts the chest, and is a great impediment to free respiration; whereas the short sized find little difficulty in keeping themselves erect, and are naturally much more active, by which the animal functions are retained in a state of greater perfection; the only disadvantage attending a short stature is, that it is frequently accompanied with corpulence, which is rather unfavourable to long life.

4. *Disposition of Mind.* Nothing is more conducive to longevity than to preserve equanimity and good spirits, and not to sink under the disappointments of life, to which all, but particularly the old, are necessarily subjected. This is a point which cannot be too much inculcated, as experience continually shows that many perish from despondency, who, if they had preserved their spirits and vigour of mind, might have survived many years longer. Neither the irritable, who are agitated by trifles, nor the melancholy, who magnify the evils of life, can expect to live long. Even those who suffer their strength and spirits to be exhausted by severe study, or other mental exertions, seldom reach great age. In the list before referred to, of 1712 persons who lived about a century, Fontenelle (who did not quite reach 100 years) is the only author of any note; and his great age is ascribed to the tranquil ease of his temper, and that liveliness of spirits for which he was much distinguished. Among those who have devoted themselves to the study or practice of music, a profession which encourages cheerfulness of mind, instances of great age have been very frequent.

5. *Occupation.* No person that leads an idle life will ever attain to great age; but health and long life must depend much on the manner in which the individual is employed. Those occupations are certainly the most conducive to the duration of life, which are carried on in the open air, and require activity or labour; thus farmers, gardeners, and labourers in the country, are in general the longest lived. Foot soldiers also, who have survived the dangers of war, are remarkable for long life: they are generally stout and vigorous men, and the regularity to which surviving soldiers must have accustomed themselves, whilst their careless and disorderly companions have dropped off, the erect posture to which they have been trained, and being of course men well formed by nature, and habituated to walk well (by which they enjoy the most natural exercise in perfection) all combine in their favour. Sailors also would furnish many instances of longevity if comfortably provided for in their old age: of this a striking proof is given in the accounts drawn up by Dr. Robertson of the pensioners in Greenwich Hospital. In the year 1801, the complement of in-pensioners was 2410, of whom there were 96 of the age of 80 years and upwards; of this number 13 were above 90 years of age, and one man 102 years old. The number of out-pensioners was about 2500, of whom it appeared there were only 23 from 80 years of age and upwards. Of the former therefore about 4 in 100 survived 80 years of age, but of the latter not 1 in 100 attained that age, a sufficient evidence of the benefits of regularity and ease in the advanced period of life, and of the attention paid to the health of the in-pensioners at that excellent institution.

6. *Mode of Living.* If persons were to live with the simplicity of ancient times, it is probable that they would attain long life, without experiencing any material illness, merely by a proper attention to air, exercise, clothing, and diet. But in the present state of society, the great bulk of the community follow, not a natural, but an artificial mode of life, and thence are perpetually exposed to various temptations, which they find it difficult always to resist, and to dangers which they cannot always avoid. Most persons however have it in their power in some degree to regulate their manner of living by their own choice; and by a little attention to their food, clothing, employment, rest, and temper of mind, might not only contribute materially to the prolongation of their lives, but preserve themselves from many diseases, and greatly increase their relish for all the enjoyments of life.

The importance of wholesome food, for

the preservation of health and promoting long life, and the avoiding of excess, whether in eating or drinking, is sufficiently obvious. Some instances, indeed, are recorded of persons who have continued to commit excesses, and have lived long; but these are to be considered in no other light than as exceptions to a general rule; and it may reasonably be contended, that if such persons lived to a great age, notwithstanding their intemperance, they would have lived much longer had they followed a different course. Experience will point out those articles of food which are best adapted to the constitution of each individual, and there cannot be a better rule than to adhere to them as far as circumstances will permit. It may be observed, however, that people in general, especially those who do not labour, eat much more than nature requires; that a little abstinence or self-denial may often be of use, either to prevent or to cure disease; and at any rate, that none but hard working people, the young who are growing fast, or persons who are travelling about, should eat more than one full meal each day.

As to clothing, much must depend on situation and climate; but it is generally found a useful practice to wear woollens next the skin. It is remarked in many parts of Scotland, that since the use of flannel shirts has been given up by the lower orders, the rheumatism and other diseases formerly unknown, have become very frequent, and are daily increasing. In the West India islands, if care be taken to make the troops wear flannel shirts, they are generally exempt from various disorders, which otherwise would probably have attacked them. Even the negroes themselves are said to prefer flannel to cotton or linen, and find it a much more comfortable and useful dress.

Exercise cannot be too much recommended; and as the inhabitants of large towns, and persons engaged in sedentary occupations, cannot take all the exercise abroad that may be necessary for their health, they ought as much as possible to accustom themselves to be walking about even in their own house, for though this practice does not make up for the want of exercise abroad, it is certainly the best substitute for it. Exercise is attended with the advantage of creating an inclination to retire early to rest, and of inducing sound sleep. Every one should take all the repose that nature requires, but should never continue long in bed without sleeping. Early rising, even if carried to an extreme, is far more conducive to health and long life, than late hours at night and slumbering in bed in the morning.

There is nothing that can tend more to long life than for a person to obtain a complete command of his passions, and in particular to preserve his mind from being ruffled by the occurrences of life. Perhaps there is no maxim more likely to promote good health, and consequently the duration of life, than that of paying a proper attention to temper, temperance, and sleep. By good temper the mind is preserved from disease; and by temperance, the body; and both the mind and the body, when exhausted, are again recruited and restored to their former strength, by a sufficient quantity of repose.

LONGIMETRY, the art of measuring lengths, both accessible, as roads, &c. and inaccessible, as arms of the sea, &c. See SURVEYING.

LONGITUDE *of a star*, in astronomy, an arch of the ecliptic, intercepted between the beginning of Aries and the point of the ecliptic cut by the star's circle of longitude. See CIRCLE, &c.

LONGITUDE *of a place*, in geography, is an arch of the equator intercepted between the first meridian, and the meridian passing through the proposed place; which is always equal to the angle at the pole, formed by the first meridian and the meridian of the place.

The first meridian may be placed at pleasure, passing through any place, as London, Paris, Teneriffe, &c. but among us it is generally fixed at London, or rather Greenwich, and the longitudes counted from it will be either east or west, according as they lie on the east or west side of that meridian. The difference of longitude between two places upon the earth is an arch of the equator comprehended between the two meridians of these places; and the greatest possible is 180 degrees, when the two places lie on opposite meridians.

Since the parallels of latitude always decrease, the nearer they approach the pole; it is plain, a degree upon any of them must be less than a degree upon the equator, in the ratio of the co-sine of the latitude to the radius. Hence, as the radius is to the co-sine of any latitude; so is the minutes of difference of longitude between two meridians, or their difference in miles upon the equator, to the distance of these two meri-

dians on the parallel of that latitude, in miles. And, by this theorem, is the following table constructed.

A TABLE,

Shewing how many Miles answer to a Degree of Longitude, at every Degree of Latitude.

D. L.	Miles.	D. L.	Miles	D. L.	Miles.	D. L.	Miles.
1	59.99	24	54.81	47	40.92	69	21.50
2	59.97	25	54.38	48	40.15	70	20.52
3	59.92	26	53.93	49	39.36	71	19.54
4	59.86	27	53.46	50	38 57	72	18.55
5	59.77	28	52.97	51	37.76	73	17.54
6	59.67	29	52.47	52	36.94	74	16.53
7	59.56	30	51.96	53	36.11	75	15.52
8	59.42	31	51.43	54	35.27	76	14.51
9	59.26	32	50.88	55	34.41	77	13.50
10	59.08	33	50.32	56	33.55	78	12.48
11	58.89	34	49.74	57	32.68	79	11.45
12	58.68	35	49.15	58	31.79	80	10.42
13	58.46	36	48.54	59	30.90	81	9.38
14	58.22	37	47.92	60	30.00	82	8.35
15	57.95	38	47.28	61	29.09	83	7.32
16	57.67	39	46.62	62	28.17	84	6.28
17	57.37	40	45.95	63	27.24	85	5.23
18	57 06	41	45 28	64	26 30	86	4.18
19	56.73	42	44.59	65	25.36	87	3.14
20	56.38	43	43.88	66	24.41	88	2.09
21	56.01	44	43.16	67	23.44	89	1 05
22	55.63	45	42.43	68	22.48	90	0.00
23	55.23	46	41.68				

Longitude, in navigation, the distance of a ship or place, east or west, from another, reckoned in degrees of the equator. As the discovery of a method to find the longitude would render voyages safe and expeditious, and also preserve ships and the lives of men, the following rewards have been offered by act of parliament, as an encouragement to any person who shall discover a proper method for finding it out: the author or authors of any such method shall be entitled to the sum of 10,000*l.* if it determines the longitude to one degree of a great circle; to 15,000*l.* if it determines the same to two-thirds of that distance; and to 20,000*l.* if it determines the same to one-half of the same distance; and that half of the reward shall be due and paid when the commissioners of the navy, or the major part of them, agree that any such method extends to the security of ships within 80 geographical miles of the shores, which are places of the greatest danger; and the other half, when a ship, by the appointment of the said commissioners, or the major part of them, shall thereby actually sail over the ocean, from Great Britain to any such port in the West Indies as those commissioners, or the major part of them, shall choose for the experiment, without losing their longitude beyond the limits before-mentioned. The French, Dutch, Spaniards, and other nations, have likewise offered rewards for the same purpose.

Since, by the motion of the earth round its axis, every point upon its surface describes the circumference of a circle, or 360°, in twenty-four hours time, it is plain it must describe 15° in one hour, because $\frac{360°}{24} = 15$. Hence the difference of longitude may be converted into time, by allowing one hour for every 15 degrees, and proportionally for minutes; also difference of time may be converted into difference of longitude by allowing 15° for every hour, and proportionally for a greater or less time. Consequently by knowing the one we can easily find the other.

Whatever contrivance, therefore, shows the hours of the day, at the same absolute point of time, in two different places, likewise serves to find the difference of longitude between those places. Now, since an eclipse of the moon proceeds from nothing else but an interposition of the earth between her and the sun, by which means she is prevented from reflecting the light she would otherwise receive from the sun, the moment that any part of her body begins to be deprived of the solar rays, it is visible to all those people who can see her at the same time; whence, if two or more different people, at two or more different places, observe the times when it first began or ended, or note the time when any number of digits was eclipsed, or when the shadow begins to cover or quit any remarkable spot, the difference of those times (if there be any) when compared together, will give the difference of longitude between the places of observation.

The longitudes of places may also be determined from the observations of solar eclipses, but these being encumbered with the considerations of parallaxes, are not near so proper as those of the moon; and each of these happening but rarely, another excellent expedient has been thought of, and that is the eclipses of Jupiter's satellites.

Now as neither Jupiter nor any of his attendants have any native light of their own, but shine with a borrowed light from the sun, it happens that each of these, in every revolution about Jupiter, suffers two eclipses, one at their entrance into the sha-

dow, the other at the entrance of their passage behind his body; whence in each revolution of the satellite there are four remarkable appearances, by the observation of any one of which the business may be done, *viz.* one at the entrance into the shadow, and one at the emersion out of it; one at the entrance behind the body, and another at the coming out; but the latter of these, *viz.* the ingress and egress of the satellite, into and from under the body, is not so much regarded by astronomers as the immersion into and out of the shadow, because, in the former, the difficulty of pronouncing the exact time is very great, it requiring, in each observer, eyes equally good and strong, and telescopes equally large; but the observation of the former of these, *viz.* the immersion into, and emersion out of the shadow, is easy and practicable, because the quick motions of the satellites plunge them so quickly into the shadow of Jupiter, that it is no difficult matter to pronounce, by any telescope by which they may be seen, the exact time of their immersion and emersion, as any one may soon be satisfied, if he will but try the experiment.

And as each of these happens at the same moment of absolute time, if two or more persons, in different places, note the time of observation, these, when compared together, will give the difference of longitude between the two places of observation. And, when we consider the great number of these eclipses that happen every year, there being more visible in one year than there are days in it, and consequently, but few nights when Jupiter may be seen, (and which is near eleven months of the year) but that an eclipse of one or other happens, and sometimes two or three in a night; the ease with which they may be made, requiring only a telescope of eight or ten feet in length, which may be almost managed with the hand; and the little likelihood there is of missing the times of ingress or egress, they being in a manner momentaneous; and lastly, the great exactness to which they would give the difference of longitude, it being certainly as exact as the latitude can at present be taken; it is much to be wondered at, that the more skilful part of our seamen have so long neglected them, and especially in the several ports into which they sail. The eclipses of Jupiter's satellites, and their configurations, are given in the nautical ephemeris.

Besides these, there is another method equally useful, expeditious, and certain; and that is, the appulses of the moon to certain fixed stars, and their occultations by the interposition of her body; for, the moon finishing her revolution in the space of twenty-seven days, seven hours, forty-three minutes, there are but few clear nights when the moon does not pass over or so near to some fixed star, that her distance from it, or the time of her visible conjunction with it, may be easily observed by the telescope, and micrometer only; and these, when compared together, or with the visible time computed to the meridian of some place, will show the difference of longitude of those places.

It is a great objection to the methods here described that the agitation of a ship at sea prevents their being useful. But the invention of Hadley's quadrant and its modern improvements, with the degree of perfection to which the moon's place can now be had, by computation, added to the great facilities afforded by the nautical almanack and requisite tables, published by the commissioners of longitude, and other works, particularly Mendoza's extensive Tables, patronized by them, have rendered the determination of the longitude at sea, a thing of easy and general practice by observations of the angular distance of the moon from a fixed star. This was first proposed by John Warner, in his Notes to Ptolemy's Geography, in 1514, and since by others, particularly our Sir Jonas Moor, Flamstead, Halley, Bradley; and in later times, with great diligence, zeal, and ability, by the present Astronomer Royal, Dr. Maskelyne. For the processes and computations the reader will have recourse to the works just mentioned. The principle is simple and easy. An observer at sea measures the angle between the moon and the sun, or a fixed star, while two other observers take their altitudes in order to determine the quantities of refraction and parallax. The two zenith distances, and the oblique distance, constitute a spherical triangle; of which the angle of the zenith may be determined, and then by correcting the altitudes for parallax and refraction two other zenith distances may be had, which are correct, and with these and the angle at the zenith, a new triangle is constituted, of which the oblique side is the correct distance. By comparing this distance with those in the nautical almanack, the time at Greenwich is obtained, and the difference between this and the time (observed by an altitude or otherwise) at the ship, gives the differ-

ence of longitude. Though this computation with tables, which give every tenth second, is not operose, it is much abridged by the formulæ given in the said works.

Time-pieces are likewise rendered so perfect at present, that they afford the most inestimable assistance to mariners. See CHRONOMETER and HOROLOGY. Our John Harrison, between the years 1726 and 1762, first vanquished the great difficulty, and was rewarded with 20,000*l.* from the English government. Very liberal encouragement has since been given to other artists, such as Arnold, Earnshaw, and others.

LONGITUDE *of motion*, according to some philosophers, is the distance which the centre of any moving body runs through, as it moves on in a right line.

LONGITUDINAL, in general, denotes something placed lengthwise: thus some of the fibres of the vessels in the human body are placed longitudinally, others transversely, or across.

LONGOMONTANUS (CHRISTIAN), a learned astronomer, born in Denmark in 1562, in the village of Longomontam, whence he took his name. Vossius, by mistake, calls him Christopher. Being the son of a poor man, a ploughman, he was obliged to suffer, during his studies, all the hardships to which he could be exposed, dividing his time, like the philosopher Cleanthes, between the cultivation of the earth, and the lessons he received from the minister of the place. At length, at fifteen years old, he stole away from his family, and went to Wiburg, where there was a college, in which he spent eleven years; and though he was obliged to earn his livelihood as he could, his close application to study enabled him to make a great progress in learning, particularly in the mathematical sciences.

From hence he went to Copenhagen; where the professors of that University soon conceived a very high opinion of him, and recommended him to the celebrated Tycho Brahe; with whom Longomontanus lived eight years, and was of great service to him in his observations and calculations. At length, being very desirous of obtaining a professor's chair in Denmark, Tycho Brahe consented with some difficulty to his leaving him; giving him a discharge filled with the highest testimonies of his esteem, and furnishing him with money for the expense of his long journey from Germany, whither Tycho had retired.

He accordingly obtained a professorship of mathematics in the University of Copenhagen, in 1605; the duty of which he discharged very worthily till his death, which happened in 1647, at eighty-five years of age.

Longomontanus was author of several works, which show great talents in mathematics and astronomy. The most distinguished of them is his "Astronomica Danica," first printed in quarto, 1621, and afterwards in folio, in 1640, with augmentations. He amused himself with endeavouring to square the circle, and pretended that he had made the discovery of it; but our countryman, Dr. John Pell, attacked him warmly on the subject, and proved that he was mistaken. It is remarkable, that, obscure as his village and father were, he contrived to dignify and eternize them both; for he took his name from his village, and in the title page to some of his works, he wrote himself Christianus Longomontanus Severini filius; his father's name being Severin or Severinus.

LONICERA, in botany, *honeysuckle*, named from A. Lonicer, a genus of the Pentandria Monogynia class and order. Natural order of Aggregatæ. Caprifolia, Jussieu. Essential character: corolla one-petalled, irregular; berry many-seeded, two-celled, inferior. There are nineteen species, of which L. grata, ever-green honeysuckle, is the most beautiful: it grows naturally in North America: it has strong branches, covered with a purple bark, which are ornamented with lucid green leaves, embracing the stalks, and continuing their verdure all the year; the flowers are produced in whorled bunches at the end of the branches; there are frequently two, and sometimes three, of these bunches rising one out of the other; they are of a bright red on their outside, and yellow within, of a strong aromatic flavour; it begins to flower in June, and there is a constant succession of flowers till the frost puts an end to them.

LOO, or *lanter-loo*, a game at cards. See LANTER-LOO.

LOOF, in the sea-language, is a term used in various senses; thus the loof of a ship is that part of her aloft which lies just before the chest-tree; hence the guns which lie there are called loof-pieces: keep your loof, signifies, keep the ship near to the wind; to loof into a harbour, is to sail into it close by the wind; loof up, is to keep nearer the wind; to spring the loof, is when

a ship that was going large before the wind is brought close by the wind.

LOOKING-*glasses*, are nothing but plane mirrors of glass; which being impervious to the light, reflect the images of things placed before them. See OPTICS.

LOOM, a frame composed of a variety of parts, used in all the branches of weaving; for a particular description of which see WEAVING.

LOOM, in the sea-language: when a ship appears big, when seen at a distance, they say she looms.

LOOM *gale*, a gentle easy gale of wind, in which a ship can carry her topsails a-trip.

LOOP, in the iron works, denotes a part of a sow, or block of cast iron, broken or melted off from the rest.

LOOP *holes*, in a ship, are holes made in the coamings of the hatches of a ship, and in their bulk-heads, to fire muskets through, in a close fight.

LOPPIUS, the *angler*, in natural history, a genus of fishes of the order Cartilaginei. Generic character: head depressed; teeth numerous and sharp; mouth armed with teeth; pectoral fins brachiated. There are eight species, of which we shall notice the following. L. europæus, or the European angler, is a native of the European seas, and measures sometimes seven feet in length, but is generally about three, in shape similar to a tadpole. It frequents the shallow parts of the sea, and imbedding itself almost completely in sand or gravel, moves its tentacula, or the long processes on its head, in various directions. The small fishes mistaking these for worms, catch at them with avidity, and in the moment of expected happiness find certain destruction. L. histrio, or the harlequin angler, is a native of the Indian and American seas, and is one of the most curious and remarkable of fishes; but we have not here room for the detail of its form and appendages. Its general length is about a foot. Its ventral fins resemble short arms, and Shaw mentions Renard's stating, that he knew an instance of some of these fishes living without water for three days, and walking about the house in the manner of a dog! For a representation of this fish see Pisces, Plate V. fig. 3.

LOPPING, among gardeners, the cutting off the side-branches of trees.

LORANTHUS, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Aggregatæ. Caprifolia, Jussieu. Essential character: germ inferior; calyx none; corolla six-cleft, revolute; stamens at the tips of the petals; berry one-seeded. There are eighteen species; these are mostly parasitical shrubs, having thick opposite leaves; and axillary flowers: natives of warm climates.

LORD's *day*. All persons not having a reasonable excuse, shall resort to their parish church or chapel (or some congregation of religious worship allowed by the toleration act) on every Sunday, on pain of punishment by the censures of the church, and of forfeiting one shilling to the poor for every offence. To be levied by the churchwardens by distress, by warrant of one justice. The hundred shall not be answerable for any robbery committed on the Lord's day. No person upon the Lord's day shall serve or execute any writ, process, warrant, order, judgment, or decree (except in cases of treason, felony, or breach of the peace), but the service thereof shall be void. Public houses are shut during the usual hours of divine service.

LORICARIA, in natural history, a genus of fishes of the order Abdominales. Generic character: head smooth; mouth without teeth; gill membrane six-rayed; body mailed. Of this genus there are, according to Gmelin, two species. Shaw enumerates seven. The L. costata is found both in the seas of India and America, and is a fish highly daring, and, by the strength and acuteness of its spines, capable of wounding and lacerating those who attempt to take it with great severity. By the fishermen in those seas they are regarded as formidable enemies. See Pisces, Plate V. fig. 4. L. callicthys, which alone we shall add to the former, is about twelve inches in length, and by the inhabitants of Surinam is regarded as a delicacy. It is stated by a writer of most ludicrous or contemptible credulity, that this fish being harassed occasionally by the shallowness of the stream which it has inhabited, makes an excursion by land in search of another that it may find deeper, or even perforates the land for the same purpose.

LOTION, in medicine and pharmacy, is such washing as concerns beautifying the skin, by cleansing it of those deformities which a distempered blood sometimes throws upon it, or rather are made by a preternatural secretion. There is reason to believe, that almost all the lotions advertised for sale as quack medicines, contain much deleterious matter, such as muriated mercury, and therefore ought never to be had recourse to.

LOTTERY, a game of hazard, in which small sums are adventured for the chance of obtaining a larger value, either in money or other articles. Lotteries are formed on various plans; but in general they consist of a certain number of tickets, which are drawn at the same time, with a corresponding number of blanks and prizes mixed together, and by which the fate of the tickets is determined. This species of gaming has been sanctioned by the governments of France, Holland, Great Britain, and other countries, as a means of raising money for public purposes; as from the contributions being voluntary, it is always easier to obtain money in this way than by new taxes: it is, however, liable to the serious objection, that it tempts many persons to lose more than they can conveniently spare, particularly among the lower classes of society, who are led to neglect the gains of honest industry for the chance of acquiring sudden riches by a prize in the lottery.

The proposals for the first public lottery in England were published in 1567 and 1568, and it was drawn in 1569, at the west door of St. Paul's cathedral. The tickets were sold at ten shillings each, and there were no blanks. The prizes consisted chiefly of plate; and the profits of it were intended for the repair of the havens of the kingdom, and other public works. In 1612 King James granted permission for a lottery, to be held at the west end of St. Paul's, of which the highest prize was of the value of 4000 crowns, in plate: this was for the assistance of the Virginia company, who were licensed to open lotteries in any part of England, by which means they raised 29,000*l.* At length these lotteries came to be considered a public evil; they attracted the attention of Parliament, were represented by the Commons as a grievance, and in 1620 were suspended by an order of council. In 1630, however, Charles I. granted a special licence for a lottery, or lotteries, "according to the course of other lotteries heretofore used or practised," for defraying the expenses of a project for conveying water to London.

Soon after the revolution, Lotteries were resorted to among other expedients for raising part of the extraordinary sums necessary for the public service, by which the disposition for this species of gambling was greatly encouraged and extended; and private lotteries, formed on the most delusive and fraudulent principles, became so general, not only in London, but in all the other principal towns of England, that parliament found it necessary, in 1698, to pass an act for suppressing them; by which a penalty of 500*l.* was laid on the proprietors of any such lotteries, and of 20*l.* on every adventurer in them; notwithstanding which, the disposition to fraud on the one hand, and for adventure on the other, continued to prevail, and small lotteries were carried on under the denomination of sales of gloves, fans, cards, plate, and other articles. This was attempted to be checked by a clause of an act passed in 1712, which only gave rise to a new mode of carrying on this kind of gaming. The adventure was now made to depend on the drawing of the government lottery; and the selling and buying of chances and parts of chances of tickets in the state lotteries became a general practice, till it was prohibited by an act passed in 1718, by which all undertakings resembling lotteries, or being dependent on the state lottery, were strictly prohibited, under the penalty of 100*l.* over and above all penalties enjoined by former acts of parliament against private lotteries.

During the reign of Queen Anne, the lotteries were generally for terminable annuities, to which both blanks and prizes were entitled, at different rates: thus, in 1710, the lottery consisted of 150,000 tickets, valued at 10*l.* each; every ticket being entitled to an annuity for thirty-two years, the blanks at 14*s.* per annum, and the prizes, to greater annuities, from 5*l.* to 1,000*l.* per annum. This was the first lottery for which the Bank of England received the subscriptions for government. In the following year, the whole of the money advanced for the tickets was to be repaid, both in blanks and prizes, in thirty-two years, with interest at 6 per cent. and an additional sum of nearly half a million to be divided in order to form the prizes; which additional capital was to be paid, with the like interest, within the same period as the original sum. In this manner, which was continued in several of the subsequent years, a very considerable premium was given for the money advanced, in addition to a high rate of interest.

According to the lottery plans which prevailed from Sir Robert Walpole's administration to that of the Duke of Grafton, the tickets were issued at 10*l.* each; and occasionally the subscription was open to the public at large. The highest prize was generally 10,000*l.* and the lowest 20*l.* There were from four to six blanks to one prize, and the blanks entitled the bearers to five or six pounds stock in 3 or 4 per cent. Bank

annuities, the value of the blanks and prizes being generally funded. The office-keepers divided the tickets into shares and chances; the former entitling the holders to the proportion they had purchased of blanks and prizes; the chances to prizes only; that is, they had no return if the ticket was drawn a blank. The tickets, according to the advantage or disadvantage of the scheme, in respect to the number of blanks to a prize, and the number of high prizes, generally sold at from 11*l.* to 12*l.* before the drawing. When the ticket sold for 11*l.* and the blank was entitled to 6*l.* in the 3 per cent. annuities, as the blank might be sold for 5*l.* 8*s.* ready money, when the 3 per cents. were at 90, the adventurer only gambled at the risk of 5*l.* 12*s.*; and at the highest calculation, when tickets were worth 13*l.* he never staked more than 7*l.* 12*s.* for a ticket before the drawing.

In 1759, the scheme of the lottery included two prizes of 20,000*l.* each, which had not been the case in any lottery since the reign of Queen Anne. The scheme for the year 1767 contained one prize of 20,000*l.* and this was for many years after the usual amount of the highest prize. About this time a material alteration was made in the plan of the lotteries; the allowance to blanks was discontinued, the whole sum being divided into prizes, the number of which was of course considerably increased, particularly as the proportion of small prizes was much greater than it has since been, and in several of the following years was less than two blanks to a prize. All the lotteries during the time Lord North was Chancellor of the Exchequer were formed on this principle, with some variations in the schemes, which favoured the holders of tickets and the lottery-office keepers, and greatly expanded the spirit of gaming: such as paying the prizes in money instead of stock, and making the first-drawn ticket for several successive days a capital prize of 1000*l.* or more, which enhanced the price of tickets, and encouraged persons who had blanks drawn to buy in again. Some judicious regulations were, however, adopted for the security of persons purchasing shares of tickets, by confining the shares into which tickets may be divided to halves, quarters, eighths, and sixteenths, and obliging all lottery-office keepers to deposit the tickets they divide into shares in the Bank, and to have the said shares examined and stamped. The practice of insuring tickets and shares was likewise restrained by enacting, that "No person shall sell the chance or chances of any ticket, or any share, for any time less than the whole time of drawing from the day of sale; nor shall receive any sum of money whatsoever, in consideration for the repayment of any sum, in case any ticket shall prove fortunate, or in any case of any chance or event relating to the drawing, either as to time, or its being fortunate; nor shall publish proposals for the same; under the penalty of 500*l.* one half to be paid to the person suing for the same, and the other moiety to his Majesty."

During Mr. Pitt's administration the lotteries were contracted for entirely distinct from the loans of the respective years; and as it became necessary to endeavour to augment every source of revenue as much as possible, various alterations were made in the lottery schemes, chiefly with the view of raising the price of tickets, and of keeping up the price during the time of drawing. The number and amount of the highest prizes were increased, some of the schemes containing four prizes of 20,000*l.* and others two of 30,000*l.*; while for the purpose of disposing of a greater number of tickets in the course of the year, the lottery was divided into two or three smaller ones, drawn at different times. The amount of the principal prizes was afterwards still further augmented; the lottery drawn in October, 1807, containing a prize of 40,000*l.* and that drawn in June, 1808, six prizes of 20,000*l.*

Notwithstanding the temptations which these schemes held out to the inconsiderate, the contractors found, either from the greater frequency of lotteries, or the increased number of tickets, that it became impossible to get the tickets off their hands, without resorting to a variety of expedients for attracting the public attention, which were carried so far as to become a public nuisance and disgrace. In 1808, a Committee of the House of Commons was appointed, to inquire how far the evils attending lotteries have been remedied by the laws passed respecting the same; who in their report were of opinion, That (in case it shall be thought expedient to continue state lotteries) the number thereof in each year should be limited to two lotteries, of not more than 30,000 tickets each; that the number of days allowed for drawing, instead of ten, should be brought back to eight for each lottery, the number fixed in 1802; that the number of tickets to be drawn each day should be uncertain, and

left to the discretion of the commissioners of stamp duties, and kept secret till the close of the drawing each day, care being taken, as the lottery proceeds, not to leave too great a number undrawn on the latter days of drawing, but that one moiety or upwards be drawn on the four first days thereof; that every lottery-office keeper should, in addition to his own licence, take out a limited number of licences for his agents; and that the limitation of hours during which lottery-offices may be open for the transaction of business, *viz.* from eight o'clock in the morning till eight o'clock in the evening, enacted by 22 George III. c. 47, and renewed in the lottery acts of 1802, and the three following years, but omitted in those of 1806 and 1807, ought in future to be re-enacted, without the exception therein made to Saturday evenings.

LOTTERIES are declared to be public nuisances, 5 George I. c. 9; but for the public service of the government, lotteries are frequently established by particular statutes, and managed by special officers and persons appointed.

By statute 42 George III. c. 54, lottery-office keepers are to pay fifty pounds for every licence in London, Edinburgh, and Dublin, or within twenty miles of either, and ten pounds for every licence for every other office; and licensed persons shall deposit thirty tickets with the Receiver-General of the Stamp Duties, or licence to be void.

By statute 22 Geo. III. c. 47, lottery-office keepers must take out a licence, and offices are to be open only from eight in the morning to eight in the evening, except the Saturday evening preceding the drawing. The sale of chances and shares of tickets, by persons not being proprietors thereof, are prohibited under penalty of fifty pounds, and, by 42 Geo. III. c. 119, all games or lotteries, called Little Goes, are declared public nuisances, and all persons keeping any office or place for any game or lottery, not authorized by law, shall forfeit five hundred pounds, and be deemed rogues and vagabonds. The proprietor of a whole ticket may nevertheless insure it for its value only, with any licensed office for the whole time of drawing, from the time of insurance, under a *bona fide* agreement without a stamp.

LOTUS, in botany, *bird's foot trefoil*, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ or Leguminosæ. Essential character: calyx tubular: wings converging longitudinally upwards; legume cylindric, straight. There are twenty-three species; these are mostly herbaceous plants, having ternate leaves, petioled with sessile leaflets and two large stipules, of the same form with the leaflets, but distinct from the petiole: peduncles solitary, axillary, and terminating; corollas chiefly yellow.

LOUICHEA, in botany, a genus of the Monadelphia Tetrandria class and order. Essential character: receptacle common penduncle-shaped, trichotomous, producing the flowers; pericarpium proper, four-parted; segments concave, subulate acuminate, irregular growing together; corolla none; filaments four, connate, inserted into the receptacle; germ superior; style bifid; seed single, arilled, within the calyx. There is but one species, *viz.* L. cervina.

LOXIA, the *grosbeak*, in natural history, a genus of birds of the order Passeres. Generic character: bill strong, thick, convex both above and below, and rounded at the base; nostrils small and round at the base of the bill; tongue truncated. These birds are timid and solitary, not distinguished by the beauty of their colours or the sweetness of their notes; and in this country also they are migratory, withdrawing to other lands to breed and rear their offspring. Latham enumerates eighty-four species, and Gmelin no fewer than a hundred; of which we shall notice the following. L. curvirostra, or the cross-bill, is about the size of a lark, and the mandibles of its bill curve in opposite directions, and cross each other at the points; and in some individuals the upper mandible crosses to the left, and in others to the right. It is found in many countries to the north of Great Britain, and breeds and remains in them for the whole year: but in some years migrates in considerable flocks. Its favourite food consists of the seeds of pines, and pine woods are always its principal haunts. It holds the cone in one of its claws, like the parrot, and has the manners of that bird in several other respects. In North America it builds on the highest firs, and attaches its nest to the trunk by means of the exuded resin. It is never known to breed in England. See Aves, Plate VIII. fig. 5. L. pyrrhula, or the bullfinch, is commonly known in this country, building in bushes of five or six feet high; changing its residence according to the season; in summer retreating from the habitations of man, in winter preferring orchards and gardens, in which it does great mischief by destroying the buds of trees.

These birds may be instructed to whistle a variety of tunes, and to utter several words, and two bulfinches have been actually taught to sing in parts; but the natural notes of these birds are monotonous and uninteresting. See Aves, Plate VIII. fig. 7. L. chloris, or the greenfinch, is abundant also in this country, where, like the former, it continues throughout the year, but changes its habitation agreeably to the seasons. The female constructs a nest with considerable attention to the warmth and comfort of her young, which she provides for with the fondest assiduity and attachment. The male divides the labours of incubation with his partner. They are familiarised with extreme ease, and will imitate the notes of other birds with great success.

LUCANUS, in natural history, a genus of insects of the order Coleoptera. Antennæ clavate, the club compressed and divided into pectinate leaves; jaws projecting beyond the head, so as to resemble horns, toothed; two palpigerous tufts under the lip. There are about twenty-six species. The principal is the L. cervus, commonly known by the name of stag-beetle, or stag-chaffer. See Plate III. Entomology, fig. 3. This is the largest of all the European coleopterous insects, being between two or three inches long. It is generally of a deep chesnut colour, with some of its parts of a blacker cast. It is chiefly found in the neighbourhood of oak trees, delighting in the honey-dew, so frequently observed on the leaves. Its larva is found in the hollows of oak-trees, residing in the fine vegetable mould usually seen in such cavities, and feeding on the softer parts of the decayed wood. It is large, and of a whitish colour, and when stretched at its length, measures nearly four inches. When arrived at its full size, which is about the fifth or sixth year, it forms a hollow in the earth in which it lies, and afterwards remaining perfectly still for the space of a month, divests itself of its skin, and commences pupa. It is now shorter than before, of a deeper colour, and exhibits in a striking manner the rudiments of the large extended jaws and broad head, so conspicuous in the perfect insect. The chrysalis lies about three months before it gives birth to the complete insect, which usually emerges in the months of July and August. The exotic species of this genus are mostly natives of America; but a very elegant species has been discovered in New Holland, which differs from the rest in being entirely of a beautiful golden-green colour, with short, sharp-pointed, denticulated jaws, of a brilliant copper-colour.

LUCERNALIA, in natural history, a genus of the Vermes Mollusca class and order; body gelatinous, wrinkled, branched; mouth placed beneath. There are three species, viz. L. quadricornus; body long-coiled, with four forked arms tentaculate at the tip. It inhabits the Northern seas, on fuci; feeds on polypi. L. phrygia; body long, papillous, with numerous globiferous arms deflected into an hemisphere; fixed at the base by a byssus or mass of filaments. It inhabits deeps in the Greenland seas, and seldom changes its abode. L. auricula resembles flask; neck round, the lower extremities dilated and surrounded with eight fasciculi of tentacula. Found in the Greenland seas, adhering very firmly to the largest ulvæ, from which it rarely moves; feeds on onisci, and is about one inch and a half long.

LUCERNE is a plant frequently cultivated in the manner of clover. Its leaves, like the latter, grow three at a joint, its stalks are erect, and after mowing, immediately spring up again from the stubble. It is made into hay, in the same manner as saintfoin, but should be mowed before it flowers. It makes the sweetest and most fattening food in the world for cattle.

LUDWIGIA, in botany, so named in honour of Christian Gottlieb Ludwig, Professor of Medicine at Leipsic; a genus of the Tetrandria Monogynia class and order. Natural order of Calycanthemæ. Onagræ, Jussieu. Essential character: calyx four-parted, superior; corolla four-petalled; capsule inferior, four-cornered, four-celled; receptacle distinct from the axis of the fruit, bearing the seeds on each side. There are four species, natives of the East and West Indies.

LUES, among physicians, is, in general, used for a disease of any kind; but, in a more particular sense, is restrained to contagious and pestilential diseases, as the lues venerea.

LUMBAGO, in medicine, a rheumatic affection of the muscles about the loins.

LUMBRICUS, in natural history, the earth-worm, a genus of the Vermes Intestina: body round, annulate, with generally an elevated fleshy belt near the head, mostly rough, with minute concealed prickles, placed longitudinally, and furnished with a lateral aperture. Gmelin has enumerated sixteen species, of which we shall notice the following: L. terrestris, dew-worm; body red, with eight rows of prickles; there are two varieties, one being as long again as the other. It inhabits

decayed wood, and the common soil, which, by perforating, it renders fit to receive rain; devours the cotyledons of young plants, and wanders about in the night; is the food of moles, hedge-hogs, and various birds. It is said to have about one hundred and forty rings; head taper; mouth at the end, round; fore-part of the worm cylindric, the rest depressed; at about one-third of its length is a prominent annulated belt; on each side of the belly a row of minute spines, distinguishable only by the touch, but which are of aid to their motion. L. marinus, the lug; back with two rows of bristly tubercles. This species inhabits the shores of the sea, where it buries itself deep in the sand, leaving a little rising with an aperture on the surface, and is used as a bait for fish. Body pale red, round and annulate, with greater and lesser rings; the first prominent, with two opposite tufts of short bristles on each; the lower part smooth. L. vermicularis, body white, with two rows of prickles; inhabits the wet and decayed trunks of trees, and among moist leaves, moving very expeditiously in humid places, but twisting itself up in dry ones: body polished, glabrous. L. edulis, body whitish flesh-coloured; subclavate behind, dilated and papillous before; mouth terminal, and surrounded with a very villose rim or wrinkle. It inhabits the sandy shores of the islands in the Indian ocean; nearly a foot long, and about as thick as a goose quill; buries itself about a foot or more deep in the sand, and is eaten by the Chinese: the rings between the villous part and the hinder end 278, and separated by an annular stria; the hind part bulbous, with a double papilla; the fore-part beset with numerous flesh-coloured ones, disposed in transverse rows.

LUNA, in astronomy, the moon. See Moon.

Luna, among chemists, signifies silver. See Silver.

LUNAR, something belonging to the moon; thus we say lunar month, lunar year, lunar dial, lunar eclipse, &c.

Lunar *caustic*, is the old name for nitrate of silver, a very powerful caustic, much used in medicine. It is also called "Lapis Infernalis," by surgeons.

LUNARIA, in botany, *honesty*, a genus of the Tetradynamia Siliculosa class and order. Natural order of Siliquosæ, or Cruciformes. Essential character: silicle entire, elliptic, compressed, flat, pedicelled; valves equal, and parallel to the partition, flat; calyx with bagged leaflets. There are three species, *viz.* the perennial, annual, and Egyptian honesty.

LUNATIC. See Idiot.

LUNATION, the period or time between one new moon and another: it is also called the synodical month, consisting of $29^d\ 12^h\ 44'\ 3''\ 11\text{-}3ds$; exceeding the periodical month by $2^d\ 5^h\ 0'\ 55''$.

LUNE, in mathematics, is a geometrical figure, in form of a crescent, terminated by the arcs of two circles that intersect each other within. Though the quadrature of the whole circle has never been effected, yet many of its parts have been squared. The first of these partial quadratures was that of the lunula, given by Hippocrates, of Scio, or Chios; who, from being a shipwrecked merchant, commenced geometrician. But although the quadrature of the lune be generally ascribed to Hippocrates, yet Proclus expressly says, it was found out by Oenopidas of the same place. The lune of Hippocrates is this: let A B C, Plate IX. Miscel. fig. 7, be a semi-circle, having its centre E; and ADC a quadrant, having its centre F; then the figure A B C D A, contained between the arcs of the semi-circle and quadrant, is his lune; and it is equal to the right-angled triangle A C F, as is thus easily proved. Since $AF^2 = 2\,AE^2$, that is, the square of the radius of the quadrant equal to double the square of the radius of the semi-circle; therefore the quadrant-area, A D C F A, is = the semi-circle of A B C E A; from each of these take away the common space A D C E A, and there remains the triangle A C F = the lune A B C D A. Another property of this lune, which is the more general one of the former, is, that if FG be any line drawn from the point F, and AH perpendicular to it; then is the intercepted part of the lune A G I A = the triangle A G H, cut off by the chord line A G; or, in general, that the small segment, A K G A, is equal to the tri-lineal A I H A. For, the angle A F G being at the centre of the one circle, and at the circumference of the other, the arcs cut off A G, A I are similar to the wholes A B C, A D C, therefore the small segment A K G A is to the semi-segment A I H, as the whole semi-circle A B C A to the semi-segment or quadrant A D C F, that is, in a ratio of equality. Again, if A B C (fig. 8) be a triangle, right-angled at C, and if semi-circles be described on the three sides as diameters; then the triangle T (A B C) is equal to the sum of the two

lunes L 1, L 2. For the greatest semi-circle is equal to the sum of both the other two; from the greatest semi-circle take away the segments S 1, and S 2, and there remains the triangle T; also from the two less semi-circles take away the same two segments S 1 and S 2, and there remains the two lunes L 1, and L 2; therefore the triangle T = L 1 + L 2, the two lunes.

LUNETTE, in fortification, an enveloped counter-guard, or mound of earth, made beyond the second ditch, opposite to the place of arms; differing from the ravelines only in their situation. Lunettes are usually made in wet ditches, and serve to defend the passage of the ditch.

LUNGS, a part of the human body, which is the cause or instrument of respiration.

LUPINUS in botany, *lupine*, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ or Leguminosæ. Essential character: calyx two lipped; anthers five oblong, five roundish; legume coriaceous. There are ten species, the most common is the L. luteus, yellow lupine, which is about one foot in height, having digitate leaves composed of seven, eight, or nine hairy leaflets, nearly two inches long: the flowers are odorous in loose spikes at the end of the branches, composed of several whorls, terminated by three or four flowers, sitting close at the top; these are succeeded by ovate flattish hairy pods, about two inches long, standing erect, inclosing four or five seeds, compressed, of a yellowish white colour variegated with dark spots: it is a native of Sicily.

LUPULUS, the *hop*, in botany, &c. See HOP and HUMULUS.

LUPUS. See CANIS.

LUPUS, in ornithology, the same with the monedula, or jackdaw. See JACKDAW.

LUPUS *marinus*, the *sea-wolf*, in ichthyology, formerly constituted a genus of malacopterygious fishes, with a compressed body, and six or more ossicles in the membrane of the gills. On the back there is only one fin, which extends almost from the head to the tail. It is a very singular fish, growing to four or five feet long. This fish is now called anarrhichas, by the generality of authors; which see.

LUPUS, in astronomy, a southern constellation, consisting of nineteen, or, according to Flamstead, of twenty-four stars.

LURIDÆ, in botany, the name of the twenty-eighth order in Linnæus's "Fragments of a Natural Method," consisting of plants whose pale and ominous appearance seems to indicate something noxious in their nature and quality: theatropa, deadly nightshade; capsicum, guinea-pepper; digitalis, fox-glove; nicotiania, tobacco, &c. are of this order. Most of the plants contained in the order are herbaceous and perennial; the roots are generally branched, sometimes tuberous; the stems and branches are cylindric: the leaves are simple, and placed alternate; the flowers are hermaphrodite; the calyx is one-piece deeply divided into five parts: the corolla consists of one petal, which is either bell, funnel, or wheel-shaped; the stamina are four or five; the seed-bud is placed above the receptacle of the flower; the seed vessel is sometimes a berry, sometimes a capsule; the seeds are numerous, and frequently kidney-shaped. These plants have an insipid taste, and a nauseous disagreeable smell; the greater part taken internally, if in considerable quantity, prove mortal, unless prevented operating by emetics, &c.

LUST, in the sea-language. When a ship heels more one way than another, she is said to have a lust that way.

LUSTRE, in mineralogy, is a term much used in modern works of chemistry. The lustre of minerals in respect of intensity, is of five kinds; 1. Splendent, when in full daylight the lustre can be seen at a great distance: 2. Shining, when at a distance the reflected light is weak: 3. Glistening, when the lustre is only observable at no greater distance than an arm's length: 4. Glimmering, when the surface held near the eye in full daylight presents a number of shining points: 5. Dull, when the surface has no lustre. There are two kinds of lustre, the metallic and common. See Thompson's Chemistry.

LUTE, a musical instrument with strings. The lute consists of four parts, *viz.* the table; the body or belly, which has nine or ten sides; the neck, which has nine or ten stops or divisions, marked with strings; and the head, or cross, where the screw for raising and lowering the strings to a proper pitch of tone are fixed. In the middle of the table there is a rose or passage for the sound; there is also a bridge that the strings are fastened to, and a piece of ivory, between the head and the neck, to which the other extremities of the strings are fitted. In playing, the strings are struck with the right hand, and with the left the stops are pressed. The lutes of Bologna are esteemed the best, on account

of the wood, which is said to have an uncommon disposition for producing a sweet sound.

LUTES. See LABORATORY.

LUTHERANS, so called from their founder, Martin Luther, an Augustine friar, and one of the earliest of the reformers. Some of the doctrines of the Lutherans, as they were originally taught by their founder, seem to have differed in but a very slight degree from those of the church of Rome, from whom Luther dissented. For that reformer held sacred, or at least connived at, many things which Calvin, Zuinglius, and the rest of the reformers, abhorred as so many of the gaudy vestments and abominations of the Whore of Babylon. Concerning transubstantiation, Luther seems to have differed more in word than in substance from the Church of Rome. He held that the body and blood of Christ were materially present in the Eucharist, though he professed his ignorance of the manner in which that presence was accomplished. It is true, he laid aside the offensive term transubstantiation, and substituted that of consubstantiation in the room of it; but whether the bread and wine are, as the Catholics declare, transubstantiated into the real body and blood of Christ, or whether, as Luther asserted, the material elements are mystically consubstantiated with the body and blood of the Saviour, by the consecration of the priest, it is clear the Catholics and the Lutherans both held the doctrine of the real presence.

Luther also tolerated the use of images, altars, wax tapers, the form of exorcism, and private confession. But the grand and leading doctrine of Lutheranism, and that on which the permanent foundation of the reformation was laid, is the right of private judgment in matters of religion. "To the defence of this proposition," says Mr. Roscoe, the candid and elegant biographer of Leo the Tenth, "Luther was at all times ready to devote his learning, his talents, his repose, his character, and his life; and the great and imperishable merit of this reformer consists in his having demonstrated it by such arguments, as neither the efforts of his adversaries, nor his own subsequent conduct, have been able either to confute or invalidate."

No sooner, however, had Luther succeeded in effecting a separation from the Church of Rome, than he set himself to establish another system of religious government; in which he manifested, that however he might abominate many of the doctrines and practices of the Papal government, he still retained no small portion of that spirit of domination by which the old church had so long been characterized. The *odium theologicum* threatened to receive new strength with the reformation, and, under the auspices of Calvin and Luther, the religious world seemed likely to derive no other benefit from the reformation than that of a change of masters. It was more easy to change the head than the heart; and the language of liberty afforded a ready but a miserable substitute for liberty itself. Nor, indeed, did Luther at all times even make use of such language as might have been expected from one who had so ably maintained that great and leading truth which inculcates the unfettered rights of private judgment. The man who could stigmatize the learned and mild Erasmus, who had defended the freedom of the human will, as "an exasperated viper;" "a vain-glorious animal," seemed but ill qualified to emancipate the religious world from the fetters of spiritual tyranny. Nor was it very flattering to the reformation, that one of its ablest defenders and founders could, in his zeal for the omnipotence of faith, declare that the Epistle of James, in which the necessity of good works is stated and enforced, is, in comparison with the writings of Peter and Paul, *a mere book of straw!* These were but ill omens of the success of the reformation. Whilst Luther was engaged in his opposition to the Church of Rome, he asserted the right of private judgment in matters of faith, with the confidence and courage of a martyr; but no sooner had he freed himself and his followers from the ecclesiastical tyranny of the Pope, than he attempted to establish another tyranny equally intolerable; "and it was the employment of his latter years to counteract the effects produced by his former labours. The great example of freedom," continues Mr. Roscoe, "which he had exhibited, could not, however, be so soon forgotten; and many who had thrown off the authority of the Romish see, refused to submit their consciences to the control of a monk, who had arrogated to himself the sole right of expounding those scriptures which he had contended were open to all." The reformation consequently gained ground, in spite of the opposition of both the Church of Rome, and the example of

the Lutherans. Aided by the invention of printing, the genuine principles of reason, philosophy, and revelation began to make rapid progress. The doctrines of justification by faith alone, and of absolute unconditional election and reprobation, could no more prevent the spread of knowlege than the worship of images, or the invocation of saints. Luther had taught the religious world, that the mind of man cannot be subjected to the imperious decrees of fallible councils and human power, and the result was glorious. The human mind, delivered from the external constraint imposed upon it by hierarchical despotisms, and from the internal constraint of the apathy in which it was kept by a blind superstition, soon found itself emancipated from guardianship, and began to make a free, energetic, and proper use of its faculties. The documents of religion were subjected to a profound criticism; and, as the study of the fathers and of councils were connected with the decretals of antiquity, history, and languages, the great objects of classical learning began to assume a new aspect, and to be illuminated by a new light. The scholastic philosophy found in the Lutherans most formidable adversaries, who unveiled its vices, and attacked its weak sides. The torch of reason, which had too long smothered in the recesses of the cloister, and glimmered in the cells of the monks, was no sooner admitted to the re-animating atmosphere of freedom and philosophy, than it began to shine forth in its native lustre. The empty science of the casuists vanished before the morality of the gospel. In short, the human mind, thus liberated from the fetters of priestcraft and tyranny, shook off the corruptions which it had gathered during the middle ages, and without fear of the inquisition here, or the terrors of eternal damnation hereafter, began to display its native activity, to probe the foundations of tottering societies, the rights of mankind, the laws of empires, and the governments of churches. May the happy influence of the reformation, thus brought into action by the fearless, though priestly Luther, continue to spread itself till the whole world is freed from the shackles of superstition, and the glorious empire of truth, reason, and religion, shall be established in every country, and its mild laws be written on every heart!

LUTRA, the *otter*, in natural history, a genus of mammalia of the order Feræ. Generic character: six cutting teeth rather sharp; canine teeth longer; feet webbed. There are eight species, of which we shall notice only the following.

L. vulgaris, or the common otter, is met with in almost all the countries of Europe, and throughout the north of Asia. It is not considered as completely amphibious, but can subsist a long while under water, lives principally upon fish, and takes its prey with great facility in rivers and lakes, in the banks of which it generally fixes its habitation, forming it with extreme elaborateness and precaution with respect to danger. When unable to procure fishes, it destroys and devours the smaller quadrupeds. It is highly fierce, and when pursued by dogs will defend itself with uncommon vigour and perseverance, uttering no sounds of pain or fear though almost torn to pieces by its assailants, but employing its last efforts of existence in inflicting upon them in return the most dreadful wounds and lacerations. The female produces four or five young in the spring. Otters have been so successfully tamed, notwithstanding all their fierceness, as to accompany their owners like dogs, and obey calls and signals with the same promptitude. Mr. Bewick relates that Mr. James Campbell possessed a young otter of this description, and which had been trained by him with such success to catch fish, that in a single day it would sometimes take ten salmon. When wearied with its hunt it would decline further exertion, and receive its reward in an ample repast on the fish it had taken, and fall almost instantaneously to sleep, being generally conveyed home in that state. It would fish in the sea as well as in rivers. Otters are sometimes seen in Guinea in large companies and of immense size, weighing not less than one hundred pounds, and so savage as to be highly dangerous. Otters are remarked for eating only the head and upper parts of the fishes which they take unless particularly pressed by hunger, and appear to have a propensity to destruction itself like the pole-cat, always killing many more animals than it can devour. See Mammalia, Plate XVI. fig. 6.

L. Marina, or the sea-otter, is about four feet and a quarter in its whole length, and is found almost solely between the forty-fourth and sixtieth degree of N. latitude, and the one hundred and twentieth and one hundred and fiftieth degree of E. longitude. Its skin is an important article of commerce between the Russians and the Chinese, and a single fur of this

animal is not unfrequently sold for the amazing price of twenty-five pounds. Sea-otters are perfectly inoffensive, and the female manifests the most affectionate attachment to her young, fondling it with endless caresses, and often throwing it in the air and catching it with the utmost caution and tenderness. These animals feed on crabs, lobsters, and other shell-fish, and frequent the shallows which are most thickly covered with sea weeds. The flesh of the young is thought particularly like lamb, and is highly valued.

LUXATION, in surgery, is when any bone is moved out of its place, or articulation, so as to impede or destroy its proper motion or office: hence, it appears that luxations are peculiar to such bones as have moveable joints.

LYCHNIS, in botany, a genus of the Decandria Pentagynia class and order. Natural order of Caryophyllei. Essential character: calyx one-leafed, oblong, even; petals five, with claws, and a sub-bifid border; capsule five-celled. There are twelve species.

LYCIUM, in botany, *box-thorn*, a genus of the Pentandria Monogynia class and order. Natural order of Luridæ. Solaneæ, Jussieu. Essential character: corolla tubular, closed at the throat by the beard of the filaments; berry two-celled, many-seeded. There are thirteen species. Several of these shrubs, from China and the Cape of Good Hope, will bear the open air in a warm situation and dry soil, when they have once acquired strength, except in very severe winters, especially if the roots are covered with litter, and the branches with mats.

LYCOPERDON, in botany, a genus of the Cryptogamia Fungi class and order. Natural order of Fungi, or Mushrooms. Generic character: fungus roundish, fleshy, firm, becoming powdery, and opening at the top; seeds fixed to filaments connected with the inner coat of the plant. These singular fungi are described by Dr. Withering; there is also an elaborate dissertation on the British stellated lycoperdons, by Mr. Woodward, in the second volume of the Transactions of the Linnean Society of London.

LYCOPODIUM, in botany, *wolf's foot*, or *wolf's claw moss*, a genus of the Cryptogamia Miscellaneæ class and order. Natural order of Musci, or Mosses. Generic character: fructifications in the axils of the scales digested into oblong imbricate spikes, or the leaves themselves, sessile; capsule kidney-shaped, two-valved, elastic, many-seeded; veil none. There are several species; six of these are natives of Britain, figured by Dillenius and others.

LYCOPSIS, in botany, *wild bugloss*, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: corolla with the tube bent in. Natives of the South of Europe.

LYCOPUS, in botany, *water horehound*, a genus of the Diandria Monogynia class and order. Natural order of Verticellatæ. Labiatæ, Jussieu. Essential character: corolla four-cleft; with one division emarginate; stamina distant; seeds four, retuse. There are three species.

LYDIAN *stone*, in mineralogy, is of a greyish black colour, which passes into velvet black; it occurs massive, and is likewise found in trapezoidal-shaped rolled pieces, with rounded angles: it is hard, but not very heavy. This mineral is found near Prague and Carlsbad, in Bohemia; in other parts of Germany, and in Scotland. When polished it is used as a test stone for determining the purity of gold and silver; owing, however, to its great hardness, it is less suited for this purpose than basalt. It takes its name from the circumstance of its being first found in the province of Lydia in Lesser Asia.

LYGEUM, in botany, a genus of the Triandria Monogynia class and order. Natural order of Gramineæ, or *Grasses*. Essential character: spathe one-leafed; corolla two on the same germ; nut two-celled. There is only one species, *viz.* L. spartum, rush-leaved lygeum, or hooded matweed, which is a native of Spain, where it is useful for making baskets and ropes, also for filling their paillasses or lower mattresses.

LYING *to*, in naval affairs, the situation of a ship when she is retarded in her course, by arranging the sails in such a manner as to counteract each other with nearly equal effort, and render the ship almost stationary with respect to her head-way; a ship is usually brought to by laying either her main-top-sail aback, the helm being put close down to leeward. This is particularly practised in a general engagement, when the hostile fleets are drawn up in two lines of battle opposite each other. It is also used to wait for some other ship, either approaching or expected; or to avoid pursuing a dangerous course, especially in foggy weather, &c.

LYMPH, a fine fluid, separated in the body from the mass of blood, and contained in peculiar vessels. It is distinguished into watery and coagulable lymph; the former, as tears for an example, is little else than water holding in solution a small portion of salt, and still less of animal matter. Coagulable lymph, which is found in the dropsy, contains a very considerable portion of albumen, so as to be viscid to the touch, and when heated to coagulate firmly, like the white of an egg.

LYMPHATICS, or LYMPHEDUCTS, in anatomy. See preceding article.

LYONS (ISRAEL), a good mathematician and botanist, was the son of a Polish Jew, silversmith, and teacher of Hebrew at Cambridge in England, where he was come to settle, and where young Lyons was born, 1739. He was a very extraordinary young man for parts and ingenuity; and showed very early in life a great inclination to learning, particularly in mathematics, on which account he was much patronised by Dr. Smith, master of Trinity College. About 1755 he began to study botany, which he continued occasionally till his death; in which he made a considerable progress, and could remember not only the Linnæan names of almost all the English plants, but even the synonyma of the old botanists; and he had prepared large materials for a Flora Cantabrigiensis, describing fully every part of each plant from the specimen, without being obliged to consult, or being liable to be misled, by former authors.

In 1758, he obtained much celebrity, by publishing "A Treatise on Fluxions," dedicated to his patron Dr. Smith; and in 1763, "Fasciculus Plantarum circa Cantabrigiam," &c. In the same year, or the year before, he read lectures on botany at Oxford with great applause, to at least sixty pupils; but he could not be prevailed on to make a long absence from Cambridge.

Mr. Lyons was sometime employed as one of the computers of the nautical almanac; and besides he received frequent other presents from the Board of Longitude for his own inventions. He had studied the English history, and could quote whole passages from the monkish writers verbatim. He could read Latin and French with ease, but wrote the former ill. He was appointed by the Board of Longitude to sail with Captain Phipps, in his voyage towards the north pole, in 1773, as astronomical observator; and he discharged that office to the satisfaction of his employers. After his return from this voyage he married, and settled in London, where he died of the measles in about two years.

At the time of his death he was engaged in preparing for the press a complete edition of all the works of the late learned Dr. Halley, a work very much wanted. His calculations in "Spherical Trigonometry abridged," were printed in the Philos. Trans. vol. lxv. for the year 1775, page 470. After his death, his name appeared in the title-page of a Geographical Dictionary, the astronomical parts of which were said to be "taken from the papers of the late Mr. Israel Lyons of Cambridge, author of several valuable mathematical productions, and astronomer in Lord Mulgrave's voyage to the northern hemisphere." The astronomical and other mathematical calculations, printed in the account of Captain Phipps's voyage towards the north pole, mentioned above, were made by Mr. Lyons. This appeared afterwards, by the acknowledgment of Captain Phipps, when Dr. Horsley detected a material error, in some part of them, in his "Remarks on the Observations made in the late Voyage, &c." 1774.

"The Scholar's Instructor, or Hebrew Grammar, by Israel Lyons, teacher of the Hebrew tongue in the university of Cambridge," the 2d edit., &c. 1757, 8vo.; was the production of his father, as was also another treatise, printed at the Cambridge press, under the title of "Observations and Inquiries relating to various parts of Scripture History," 1761.

LYRE, a musical instrument of the string kind, much used by the ancients. From the lyre, which all agree to have been the first instrument of the string kind in Greece, arose an infinite number of others, differing in shape and number of strings, as the psalterion, trigon, sambucus, pectis, magadis, barbiton, testudo, (the two last are used promiscuously by Horace with cythara and lyra) epigonium, simmicium, and pandoron; which were all struck with the hand, a plectrum or a little iron-rod. We have no satisfactory account of their shape, structure, or number of strings; their bare names only have been transmitted to us by the ancients. We see, indeed, numbers of instruments on old medals; but whether they are any of these, we cannot find out. The modern lyre, or Welsh harp, consisting of forty strings, is sufficiently known. The lyre among poets, painters, statuaries, carvers, &c. is attributed to Apollo and the Muses.

LYRE, in astronomy, a constellation of the northern hemisphere. See ASTRONOMY.

LYRIC, in general, signifies something sung or played on the lyre; but it is more particularly applied to the ancient odes and stanzas, answering to our airs and songs, and may be played on instruments. This species of poetry was originally employed in celebrating the praises of gods and heroes, though it was afterwards introduced into feasts and public diversions. Mr. Barnes shows how unjust it is to exclude heroic subjects from this kind of verse, which is capable of all the elevation such matters require. The characteristic of this kind of poetry is, according to Trap, the sweetness and variety of the verse, the delicacy of the words and thoughts, the agreeableness of the numbers, and the description of things most pleasing in their own natures. At first the lyric verse was only of one kind, but afterwards they so continued to vary the feet and numbers, that the variety of them now are almost innumerable.

This kind of poem is distinguished from all other odes, by the happy transitions and digressions which it beautifully admits, and the surprising and natural easy returns to the subject, which is not to be obtained without great judgment and genius.

The lyric is, of all kinds of poetry, the most poetical, and is as distinct, both in style and thought, from the rest, as poetry is in general from prose: it is the boldest of all other kinds, full of rapture, and elevated from common language the most that is possible: some odes there are likewise, in the free and loose manner, which seems to avoid all method, and yet are conducted by a very clear one, which affects transitions seemingly without art, but for that reason have the more of it; which are above connection, and delight in exclamations and frequent invocations of the muses, which begin and end abruptly, and are carried on through a variety of matter with a sort of divine pathos, above rules and laws, and without regard to the common forms of grammar. Pindar has set his successors the example of digressions and excursions. To write a lyric poem are required not only a flowing imagination, brightness, life, sublimity, and elegance, but the nicest art and finest judgment, so as to seem luxuriant, and not be so; and under the show of transgressing all laws, to preserve them.

LYSIMACHIA, in botany, *loosestrife*, a genus of the Pentandria Monogynia class and order. Natural order of Rotaceæ. Lysimachiæ, Jussieu. Essential character: corolla wheel-shaped; capsule globular, mucronate, ten-valved. There are twelve species, most of these have perennial roots, herbaceous stems, and the leaves opposite; flowers axillary, or terminating solitary, or else in spikes or corymbs.

LYTHRUM, in botany, *willow-herb*, a genus of the Dodecandria Monogynia class and order. Natural order of Calycanthemæ. Salicariæ, Jussieu. Essential character: calyx twelve-toothed; petals six, inserted into the calyx; capsule two-celled, many-seeded. There are eighteen species.

LYTTA, in natural history, a genus of insects of the order Coleoptera. Antennæ filiform; four feelers, unequal, the hind ones clavate; thorax roundish; head inflected, gibbous; shells soft, flexile, as long as the abdomen. There are upwards of thirty species.

M

M, Or m, the twelfth letter and ninth consonant of our alphabet: it is a liquid and labial consonant, pronounced by striking or moving the under lip against the upper one: its sound is always the same in English, and it admits no consonant after it in the beginning of words and syllables, except in some Greek words, nor does it come after any in that case. It suffers not the sound of *n*, coming after it, to be heard, as in autumn, solemn, &c.

As a numeral, M stands for mille, a thousand; and with a dash over it, thus, $\overline{M}$, for a thousand times a thousand, or, 1,000,000. M. A. magister artium; M. D. medicinæ doctor; MS. manuscript; and MSS. ma-

nuscripts, in the plural. In the prescription of physicians, M. stands for manipulus, a handful; and sometimes for misce, or mixtura: thus M. F. Jupalium, signifies mix and make into a julep. In astronomy, &c. M is used for meridian or meridional.

MABA, in botany, a genus of the Dioecia Triandria class and order. Essential character: calyx trifid; male, corolla trifid; female, drupe superior, two-celled. There is but one species, viz. M. elliptica. This is a smooth tree, with the twigs and young leaves hairy; leaves alternate, on short petioles, elliptic, and veined; peduncles axillary, short, often three-flowered; flowers small, and remarkable for having the outside of the calyx and corolla more villose than the rest of the plant. There is another species, or variety, which Foster calls maba major; for this reason, the drupe, or fruit, is three times the size of the other, having three-sided kernels in the cells, which are tough and insipid; they are, however, eaten by the inhabitants: in all the Friendly Islands they plant this tree about their houses.

MABEA, in botany, a genus of the Monoecia Polyandria class and order. Natural order of Tricoccæ. Euphorbiæ, Jussieu. Essential character: calyx one-leafed, five-toothed; corolla none: male, filaments nine to twelve, inserted into the bottom of the calyx: female, germ and style one; stigma three, revolute; capsule covered with a thick bark, three-celled, three-seeded. There are two species, viz. M. piriri, and M. tarquari, both shrubs, yielding a milky juice; the Negroes use the smaller branches for pipes, for which reason the trees are called pipe wood, or *bois a calumet*.

MACAO, or MACAW, in ornithology, a name given to the larger species of parrots with very long tails. See PSITTACUS.

MACARONIC, or MACARONIAN, an appellation given to a burlesque kind of poetry, made up of a jumble of words of different languages, and words of the vulgar tongue latinized.

The Italians are said to have been the inventors of it. The Germans, French, Spaniards, &c. have also had their macaronic poets; nor is Great Britain outdone in this respect, witness Drummond of Hauthornden's poem called Polemo Middinia, which begins thus:

Nymphæ, quæ colitis highissima monta Fifæa,
Seu vos Pittenweema tenet, seu Crelia crafta, &c.

MACE, the second coat or covering of the kernel of the nutmeg, is a thin and membranaceous substance, of an oleaginous nature, and a yellowish colour; being met with in flakes of an inch and more in length, which are divided into a multitude of ramifications. It is of an extremely fragrant, aromatic, and agreeable flavour, and of a pleasant, but acrid and oleaginous taste. See NUTMEG.

MACERATION, in pharmacy, is an infusion of, or soaking ingredients in water, or any other fluid, in order either to soften them or draw out their virtues.

MACHINE, in general, whatever hath force sufficient to raise or stop the motion of a heavy body.

Machines are either simple or compound; the simple ones are the seven mechanical powers, viz. lever, balance, pully, axis and wheel, wedge, screw, and inclined plane.

From these the compound ones are formed by various combinations, and serve for different purposes; in all which, the same general laws take place, viz. that the power and weight sustain each other, when they are in the inverse proportion of the velocities they would have in the directions wherein they act, if they were put in motion. Now, to apply this law to any compound machine, there are four things to be considered: 1. The moving power, or the force that puts the machine in motion; which may be either men or other animals, weights, springs, the wind, a stream of water, &c. 2. The velocity of this power, or the space it moves over in a given time. 3. The resistance, or quantity of the weight to be moved. 4. The velocity of this weight, or the space it moves over in the same given time.

The two first of these quantities are always in the reciprocal proportion of the two last: that is, the product of the first two must always be equal to that of the last: hence, three of these quantities being given, it is easy to find the fourth; for example, if the quantity of the power be 4, its velocity 15, and the velocity of the weight 2, then the resistance, or quantity of the weight, will be equal to $\frac{4 \times 15}{2} = \frac{60}{2} = 30$.

Compound machines are extremely numerous, as mills, pumps, wheel-carriages, clocks, fire-engines, &c. See ENGINE, MILL, PUMP, WATER-*works*, &c.

Machine denotes any thing that serves to augment or regulate moving powers, or it is a body designed to produce motion, so as to save either time or force. Machines

are either simple or compound. The simple machines are the mechanical powers, viz. the lever, the wheel and axis, the pulley, the inclined plane, the wedge and the screw. See MECHANICS.

These simple machines serve for different purposes, and it is the business of the skilful mechanician to select and combine them in such a manner, as may be best adapted to produce the effect of which he stands in need. Compound machines are formed from these simple ones. These may be indefinitely varied, and they belong to all the branches of science. Descriptions of many of the most useful, and which serve to exhibit the principles of machinery, will be found in various parts of our work. See ENGINE, HYDRAULICS, PNEUMATICS, &c. &c.

The modes of applying mechanical forces are almost as various as the machines that are constructed, and the purposes for which they are employed. In general the human strength is applied by means of levers, or winches, or by walking wheels, which slide beneath them as they attempt to ascend. The force of other animals is applied by a horizontal arm projecting from a vertical axis, to which they are harnessed. When motion is simply communicated to a substance placed before the moving body, such materials are used as are capable of exerting a repulsive force; but when the body to be moved is behind the moving power, and is pulled along with it, chains or ropes are sometimes more convenient. When the direction of motion communicated is also to be changed, levers or cranks may be employed, united by joints or hinges of various kinds. Sometimes a long series of connected rods is suspended by other rods or chains, so as to convey the effect of the force to a considerable distance; in this case the motion is generally alternate, as when pumps are worked by means of a water-wheel at a distance from the shafts in which the pumps are placed. For the communication of a rotatory motion, Dr. Hooke's universal joint, formed by a cross, making the diameters of two semicircles, one of which is fixed at the end of each axis, is frequently used. The best mode of connecting a rotatory motion with an alternate one is, in all common cases, to employ a crank, acting on one end of a long rod which has a joint at the other. If the rotatory motion of the crank be equable, the progressive motion of the rod will be gradually accelerated and retarded, and for a considerable part of the revolution the force exerted will be nearly uniform. The force applied to a machine may, in general, be divided into two portions, the one employed in opposing another force, so as to produce equilibrium only, the other in generating momentum. With respect to the first portion, a single crank has the inconvenience of changing continually the mechanical advantage of the machinery; with regard to the second, its motion in the second quarter of its revolution is accelerated, instead of being retarded, by the inertiæ which this portion of the force is intended to overcome, hence the motion is irregular. This difficulty may be remedied by employing cranks in pairs, one of which being fixed so as to make a right angle with the other, which is moreover the best position for two winches to be turned by two labourers; since the point of the circle, in which a man can exert his greatest strength, is nearly at the distance of a right angle, or a little more, from the point at which his force is smallest. But of all the modes of communicating motion, the most extensively useful is employment of wheel-work, which is capable of varying its direction and its velocity without any limit. See WHEEL-*work*.

MACHINE, *electric*. The electric machine consists of three parts, the electric body, which is rubbed; the rubber, which is a compounded conductor; and the prime conductor, which is destined to receive and convey the electricity, in making experiments. The first electrical apparatus consisted of a tube of glass, or a stick of sealing-wax, rubbed by the hand. Glass globes whirled quickly on an axis, were substituted as an improvement, and the rubber was still the hand; but subsequently a round concave cushion. These were succeeded by glass cylinders, which are cheap, safe, and considerably powerful; but the present fashion determines in favour of flat glass plates, on account of the advantage of a large surface, rubbed by two or more pairs of cushions, and the equality of pressure which causes the supply of electricity to be steady and without undulation, as to its quantity. Machines of very great power (see "Nicholson's Journal," quarto), have been made by M. Walckiers, consisting of an endless web or jack-towel of silk, passing between two pair of cylindrical rubbers, faced with cat-skin; the electricity being communicated to a prime conductor, lying between the parallel pieces of the silk.

The rubber is usually a piece of wood fitted to the surface intended to be subjected to friction, and covered first with two or three thicknesses of elastic cloth, then with smooth leather, and lastly with a flap of silk, pasted upon the edge at which the glass in its rotation arrives, and passing loose over the face of the cushion, and thence upon the surface of the glass, as far as the commencement of the prime conductor. Its use has been explained under the article EXCITATION.

In fig. 1, Plate Machine Electric, A represents the glass cylinder of a machine, turned by, B, the handle. Its surface rubs against, C, the cushion, from which proceed, D, the silk flap, and the electricity is conveyed to, E, the prime conductor. The supports of the cylinder, the cushion, and (indispensably) of the prime conductor, are made of glass or baked wood, in order that the electricity may not be conveyed to the earth, unless when the operator chooses to make the communication by some conducting body. A prime conductor is sometimes applied to the rubber.

Though we have produced as strong an excitation as we have ever heard of, by the amalgam of mercury and zinc, with a little tallow, as mentioned under the article EXCITATION, yet as many electricians, particularly the experienced Mr. Cuthbertson, prefers tin and zinc, and it is probable, that this mixture may afford a speedier oxydation; we shall give his receipt.

Melt two parts of tin and zinc in a crucible, and pour them on two parts of mercury in a wooden box made for that purpose, which close and agitate till the metals are cold. Then pulverize the granulated mass very finely, and make it into a paste with hog's lard.

Fig. 2, shews the plate machine, with Nicholson's cylinder improvements for changing the two states at pleasure, as adapted by Dr. Von Marum, of Haerlem.

The glass plate, G G, is fastened to the axis, B B, by means of a screw on the axis passing through a hole in the centre of the plate, and secured by a nut, C, on the opposite side. The axis is supported by a single pillar, A, which for this purpose is provided with a bearing piece, K, on which are two brass collar pieces, that carry the axis; and on the end of the axis, opposite the glass, is a counterpoise, O, of lead, to prevent too great a friction in the collar nearest the handle. The arc of the conductor, E E, which carries the two small receiving conductors, F F, is fixed to an axis turning in the ball, H. On the other side of the plate is the other arc, I, of brass wire, fixed in the bearing piece, K, but so as to admit of being turned round like the arc E E. P is a copper tube, moving like a radius on the stem of the ball, S, which, being screwed into the conductor, H, serves to confine the arm, P, in any position that may be required. The dissipation of electricity along the glass supports is prevented by a kind of cap, T, of mahogany, which affords an electrical well or cavity underneath, and likewise effectually covers the metallic cap into which the glass is cemented. The lower extremity of the pillar is guarded in the same manner by a hollow piece or ring of mahogany, V. The three glass pillars are set in sliding pieces, WWW, adjustable by screws; at each extremity of the horizontal diameter of the plate are two rubbers, X, one on each side, pressed regularly and uniformly against the plate by means of a spring, Y, the force of pressure of which is regulated by means of a screw. To these rubbers are attached silk flaps, Z Z, those of one pair of rubbers descending, and those of the other pair ascending, in the direction in which the plate is worked. A piece of fine dry writing paper, as long as the rubber, and half an inch broader, so as to cover the seam that fastens the silk to the leather, allows greater pressure to be employed by diminishing the friction, and prevents both the glass and silk from being soiled by the amalgam, so that the excitement is more powerful, and the amalgam requires to be renewed less frequently. As the semicircular branch of the prime conductor is moveable, it may be made to exhibit the electricity of the rubber at any time, by placing the cylindrical ends in contact with the cushions, the semicircular wire, I, being at the same time turned so as to cross it at right angles, which insulates the cushions. When the conductor is required to give electricity from the glass, the arc I must be in contact with the cushions, and the arc E E perpendicular to the horizon.

If the insulated prime conductor of a machine be well polished, and without corners or angles, it will retain its electric state very well, and will emit strong sparks upon the approach of any uninsulated conductor. If the uninsulated conductor be broad, round, and polished at the end, the sparks will be short and dense, and will produce a considerable sound; if less broad, the spark

will be long, crooked, and less sounding; if the breadth be still more diminished, the conductor begins to come under the denomination of a pointed body, the electric matter passes to it from the prime conductor, through a great space of air, with a hissing or rustling noise, and in a continual stream: a still greater sharpness enables the electricity to pass over a greater space, but silently, and nothing is seen but a small light upon the point. If a similar point issue from the prime conductor, and the uninsulated conductor be round and polished, the same effects happen in like situations; but if both be pointed, the electricity is more readily discharged: and in all these cases the appearance of the electric matter at the point of the prime conductor will be that which is peculiar to its electricity, a large divergent cone, if positive, or a small globular light or cone, if negative, and the light at the point presented to the prime conductor will be distinctive of the contrary electricity. Whether a pointed conductor be electrified positively or negatively, if the nose be brought near the point during the electrization, a wind will be felt blowing from the point, and the sense will be affected with a sulphureous or phosphoreal smell.

The reaction of the force by which the air is put into motion, is exerted on the pointed body. This is shewn by a pleasing experiment with an electrified wire; thus, to the middle of the wire, or rather between two wires that lie in the same line, is affixed a centre-cap like those used in sea-compasses, so that the wire may easily be moved on a point in a horizontal direction, as magnetical needles are: and the ends of the wire are pointed and bent contrary ways, to point in the direction of the tangent to the circle described by them. Now if this wire, thus suspended on a point, be insulated and electrified, its sharp ends will become luminous, and it will revolve in a direction contrary to that in which its ends are bent; or if it be suspended on an uninsulated point, and brought near the electrified prime conductor, the same effect will follow.

It may be thought strange that the air should issue from an electrified point, whether its electricity be positive or negative. It is easy to conceive that the issuing out of the electric matter may cause the air to move in the same direction; but it appears odd, that the electric matter rushing towards a point should cause the air to move directly contrary, that is to say, likewise from the point. If, however, the circumstance be examined more narrowly, the difficulty will vanish. For it is highly probable that the electric matter passes too swiftly to excite any motion in the air, but that undulation wherein sound consists; to which may be added, that if the electric matter do act on the air to put it in motion, the air must react with an equal force; and, therefore, that a current of air blown against the course of the electric matter must affect its appearance, by retarding the rays and deflecting those against which it struck obliquely: the contrary to which is, by experience, known to obtain; for the luminous cones are not sensibly affected by such treatment. The air being thus indifferent as to the motion of the electric matter, its motion may be shewn to depend on the established principles of electricity. The point is electrified either positively or negatively, and the air, immediately opposite and contiguous to the point, must, by the emission or exhaustion of the electric matter, become strongly possessed of an electric state of the same kind with that of the point: it is therefore repelled and replaced by other air which is also electrified and repelled, by which means a constant stream is produced blowing from the point, and that equally, whether the electrization be positive or negative. And, the point repelling the air must itself also be equally repelled in the contrary direction; whence the horizontal wire above described is turned, and that always one way, namely, contrary to that in which the air is moved, or to the direction of its bent points.

If an insulated conductor, free from points, be brought within a certain distance of the prime conductor or cylinder in an electric state, it will also exhibit signs of electricity of the same kind; but if those signs be removed, by taking the spark, and the conductor taken from the prime conductor, it will exhibit signs of the contrary electricity. This is a very remarkable appearance, but may be accounted for, if two suppositions be admitted, *viz.* first, that the electric matter is attracted by conducting bodies; and, secondly, that the parts of the electric matter mutually repel each other, the forces of each power being in a certain inverted ratio of the distance.

For the electric matter, in an insulated and uniform conductor, will then be equally diffused through its whole mass, and the attraction which that conductor will exert

over the surface of the glass which projects on every side; but if the glass plate be thin, in which case, at an equal intensity, it admits of a much greater charge, the discharge will be made through its substance. Glass, as thick as one eighth of an inch, may be penetrated by this means, one or more holes being made where the electric matter has passed, in which holes the glass is pulverised, and may be picked out with a pin.

It is not possible to charge an electric plate by inducing an electric state on one of its surfaces, unless the other be at the same time sufficiently near to a non-electric to assume the contrary state by emitting or receiving the electric matter.

If a plate of glass be laid upon an uninsulated plate of metal, the upper surface may be rendered electric by friction, or by applying an electrified body successively to its parts. This electricity may be taken off by touching the upper surface with an uninsulated metallic plate of the same dimensions as that upon which the glass is placed, but will not be entirely taken off, because the communication between the two surfaces in this method is not perfect, and because the metal cannot by ordinary means be brought into actual contact with the glass. The small quantity which remains, produces an effect which has been mistaken for a perpetual electricity. For if a plate of metal, to which a glass handle is affixed, be laid upon the glass, this small quantity of electricity will influence the metal, and, without actually communicating the electric matter, will cause it to exhibit a similar state. If this be taken off, by drawing the spark, and the metal then removed, by means of the glass handle, it will be found possessed of the contrary state of electricity, and another spark may be obtained. The metallic plate may be then again applied to the surface of the glass, and the process again repeated, and so on for a prodigious number of times, without any sensible difference in the event. For the electricity at the surface of the glass being almost in the natural state, as to condensation, does not disappear for a very long time, and the very near approach of the metal enables it to produce the same effect as would be obtained at a greater distance from a stronger electricity. This is made obvious, by bringing the metallic plate near the surface of the glass before its first strong electricity is taken off, for the same event is then perceived at the distance of four, five, or six inches, as in the former case is produced by contact.

The vapours of the atmosphere are continually attaching themselves to the surface of cold glass, and by that means destroy the electricity. Sulphur, wax, or resin, being less subject to this, retain their electric state much longer. A plate of glass or wood, coated over with any substance of this nature, may be excited by friction, and will produce electricity in a metallic plate, in the manner above described, for a very great length of time. Such a plate, together with its metal, has been named the electrophorus, fig. 3.

If the discharge of an electrified plate be made by the parts of a living animal, a considerable pain will be felt chiefly at the extremities of the muscles. For example, if the lower metallic plate be touched with one hand, and the other brought to the upper plate, at the instant of the emission, a pain will be felt at the wrist and elbows, which as instantly vanishes. If a larger glass plate be used, the pain will be felt on the breast; if yet larger, the sensation will be that of a universal blow. This sensation has obtained the name of the shock, and will deprive animals of life, if sufficiently strong. The shock from thirty square inches of glass, well charged, will instantly kill mice, sparrows, or other small animals. Six square feet of glass will deprive a man of sensation for a time, if the head be made a part of the circuit through which the electricity moves. No inconvenience has been found from the electric shock by men of strong habits; but women of delicate constitutions have had convulsions from a violent shock. It may be observed, that the electric shock is a proof that the electric matter can pass through the substance of non-electrics, and is not universally conducted along the surfaces alone, as some have supposed.

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on any mass of electric matter presented from without, must be the excess of the attractive force of the body over the repulsive force of the electricity it contains. Whence a given conductor will attract the electric matter the most powerfully when the quantity it already possesses is the least possible, and its attractive force will decrease as it becomes more saturated with electricity. Let two equal conductors, composed of like matter, be brought within a small distance of each other, then if the quantities of electricity they contain be equal, the attractions they mutually exert on those quantities will be equal, and it will remain undisturbed in each body. But if one conductor, A, contain more electricity than the other, B, the attractive power of B will be greatest, and will draw the electric matter from A, till an equilibrium is obtained. It follows also, that in a number of conducting bodies, communicating with each other, the electric matter will be every where of the same density, if the greatest attractive force of the bodies be supposed equal; but if different bodies be supposed to attract the electric matter with different forces, as is most probable, the densities must vary with the forces. This may be called the natural state.

To apply this to the particular instance above recited, suppose the end of an insulated conductor to be brought near the prime conductor in a positive state, the attractive power of the first mentioned conductor is greater than that of the prime conductor, yet, not being sufficient to draw sparks, at the given distance, the only effect it can produce is to make the electric matter accumulate, and become more dense in that part of the prime conductor, near which it is presented; by which accumulation the rest of the prime conductor becomes less electrified, as experience testifies. This accumulated body of electricity repels, and consequently rarifies the electric matter naturally contained in that end of the conductor, which is presented to the prime conductor; the rest of the fluid becomes more dense, and the other parts of the conductor which is presented, exhibit signs of electricity; yet, as this conductor in the whole contains no more than its natural quantity, if the electric state be taken off by drawing the spark, and it be afterwards removed from the vicinity of the prime conductor, it becomes negative throughout, by reason of the loss of the spark. If a conductor be presented to the prime conductor in a negative state, the effects are reversed, the attraction being strongest at the prime conductor, and the accumulation being in the conductor which is presented, it exhibits a negative state, which being destroyed, upon removal it becomes positive, by reason of the spark which was given to it when apparently negative.

These effects are more considerable the less the distance is between the two conductors; and the intercedent electric body is peculiarly affected: the manner of which may be better understood by observing the phenomena of non-electrics, separated by electrics which are less liable to allow the passing of the spark than the air is.

Upon an insulated horizontal plate of metal, lay a plate of glass, considerably larger, so that there may be a rim of three or four inches projecting beyond the metal on every side. Upon the glass lay another plate of metal, of the same size as the former, so as precisely to cover it. Electrify the upper plate, and the lower will exhibit signs of electricity. Continue the electrization, and the lower plate will emit sparks to an uninsulated body for a time, and afterwards cease. Separate the plates from the glass without uninsulating them, and the glass will appear to be possessed of the contrary electricities on the opposite sides. That side which communicated with the prime conductor, during the electrization, will have a like electricity, and the other the contrary. Take off the electricity of the plates of metal, and carefully replace the glass on the lower, without destroying the insulation, and also replace the upper plate with the same precaution. Then, with one end of an insulated wire, not pointed, but knobbed at the ends, touch one of the plates, and bring the other end near the other plate: the consequence will be that a strong and loud spark will pass between it and the wire, the electricity of the glass will be discharged, and the plates and the wire will exhibit few or no signs of electricity.

An electric body, the surfaces of which are thus possessed of the contrary electricities, is said to be charged. The insulation of the lower metallic plate, and of the discharging wire is not necessary, except for the purpose of drawing inferences, respecting the manner of charging the electric plate. If the electricity of the prime conductor be strong, and the glass thick, the discharge will often be made by a spark from the one metallic plate to the other,

over the surface of the glass which projects on every side; but if the glass plate be thin, in which case, at an equal intensity, it admits of a much greater charge, the discharge will be made through its substance. Glass, as thick as one eighth of an inch, may be penetrated by this means, one or more holes being made where the electric matter has passed, in which holes the glass is pulverised, and may be picked out with a pin.

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wire terminating with a knob, considerably above the mouth of the jar, fig. 4. When it is required to be charged, it may be held in the hand, or placed on an uninsulated table, and the knob of the wire applied to the conductor; the inside coated surface becomes possessed of the electricity of the conductor, and the external surface acquires the contrary electricity, by means of its uninsulated coating. When a jar of this kind is highly charged, it will discharge spontaneously over the uncoated surface, and seldom through the glass, whereas, when the uncoated surface is large, it is more apt to break by that means, and become useless. Yet, there is no certainty that a jar, which has discharged itself over its surface, will not at another time break by a discharge through the glass, as the contrary often happens. If paper covered with tin-foil be used for the coating, with the paper next the glass, the jar will be less liable to break.

A jar of considerable thickness, with a neck like a bottle, in which is cemented a thick tube to receive the wire, will sustain a very high charge, and produce much greater effects than one of the last description. The charging wire being inserted loosely into the tube, will fall out on inverting the jar, and the charge will remain for several weeks without much loss. A jar thus charged, may be put into the pocket, and applied to many purposes that the common jar cannot be used for.

If the inside of the jar be considerably damped, by blowing into it, through a tube reaching to the bottom, it will take a charge nearly one-third greater than in the ordinary state.

When a greater degree of electric force is required, larger jars must be used, in which the form is of no consequence, except as far as relates to convenience. But it is less expensive, and nearly as effectual, to use a number of smaller jars, having the same quantity of coated surface as the large jars. In this case, a communication must be formed between all the outside coatings, which may be done by placing them on a stand of metal; and also between all the inner coatings, which is best done by means of wires. Such a collection is called a battery, and may be charged and discharged like a single jar, fig. 5.

In discharging electrical jars, the electricity goes in the greatest quantity through the best conductors, and by the shortest course. Thus, if a chain and a wire, communicating with the outer coating, be presented to the knob of a jar, the greater part of the charge will pass by the wire, and very little by the chain, which is a worse conductor, by reason of its discontinuation at every link. When the discharge is made by the chain only, sparks are seen at every link, which is a proof that they are not in contact; and as the chain must be stretched by a considerable force before the sparks cease to appear on the discharge, it follows that there is a repulsive power in bodies, by which they are prevented from coming into contact, unless by means of a certain force.

By accurate experiments it appears, that the force of the electric shock is weakened, that is, its effects are dimininished, by using a conductor of great length in making the discharge. Dr. Watson, and other gentlemen of eminence in the philosophical world, were at the pains of making experiments of the same kind, but much more accurate. They found, by means of wire insulated on baked wood, that the electric shock was transmitted instantaneously through the length of 12,276 feet.

When any animal or substance is to be subjected to the shock, it is done by means of two chains, one of which connects one extremity of the animal or substance with the outer coating, and the other being made to touch the other extremity, is applied to the knob of the inner coating to make the discharge. The animal or substance thus forming a part of the circuit, receives the whole shock. The strong shock of a battery will melt wire of the seventieth of an inch in diameter, and wires of less diameters are frequently blown away and dispersed; and the effect is the same with equal quantities of electricity, whether the intensity be greater or less, within certain extended limits. Gunpowder may be fired by a charge of three square feet: the method is, to put it into a quill, and thrust a wire into each end, so as not to meet, and then make these wires a part of the circuit. A less charge will serve if iron filings be mixed with the gunpowder. Alcohol, ether, or a mixture of common air and hydrogen may also be fired by the same means, or even by the spark from the conductor.

If the ball of a thermometer be placed in a strong current of electricity, the mercury or spirit will rise many degrees.

If a thin bottle be exhausted of air by means of the air-pump, it will receive a considerable charge by applying its bottom to

the electrified prime conductor, during which time the electric matter will pass through the vacuum between the hand and the inner surface of that part of the glass which is nearest the prime conductor. This appearance is exceedingly beautiful in the dark, especially if the bottle be of a considerable length. It exactly resembles those lights which appear in the northern sky, and are called streamers, or the aurora borealis. If one hand be applied to the part of the bottle which was applied to the conductor, while the other remains at the neck, the shock will be felt, at which instant the natural state of the inner surface is restored by a flash, which is seen pervading the vacuum between the two hands.

MACHINERY, in epic and dramatic poetry, is when the poet introduces the use of machines, or brings some supernatural being upon the stage, in order to solve some difficulty, or to perform some exploit out of the reach of human power. The ancient dramatic poets never made use of machines, unless where there was an absolute necessity for so doing; whence the precept of Horace,

"Nec Deus intersit, nisi dignus vindice nodus—inciderit."

It is quite otherwise with epic poets, who introduce machines in every part of their poem; so that nothing is done without the intervention of the gods. In Milton's Paradise Lost, by far the greater part of the actors are supernatural personages: Homer and Virgil do nothing without them; and in Voltaire's Henriade, the poet has made excellent use of Saint Louis.

MACKREL, in ichthyology. See Icomber.

MACLAURIN (Colin), in biography, a most eminent mathematician and philosopher, was the son of a clergyman, and born at Kilmoddan in Scotland, in the year 1698. He was sent to the university of Glasgow in 1709; where he continued five years, and applied to his studies in a very intense manner, and particularly to the mathematics. His great genius for mathematical learning discovered itself so early as twelve years of age; when, having accidentally met with a copy of "Euclid's Elements" in a friend's chamber, he became in a few days master of the first six books without any assistance; and, it is certain, that in his sixteenth year he had invented many of the propositions which were afterwards published as part of his work, entitled, "Geometriæ Organica." In his fifteenth year he took the degree of Master of Arts; on which occasion he composed, and publicly defended, a thesis on the power of gravity, with great applause. After this he quitted the university, and retired to a country seat of his uncle, who had the care of his education; his parents being dead some time. Here he spent two or three years in pursuing his favourite studies; but in 1717, at nineteen years of age only, he offered himself a candidate for the professorship of mathematics in the Marischal College of Aberdeen, and obtained it after a ten day's trial, against a very able competitor.

In 1719, Mr. Maclaurin visited London, where he left his "Geometria Organica" to print, and where he became acquainted with Dr. Hoadley, then Bishop of Bangor, Dr. Clarke, Sir Isaac Newton, and other eminent men; at which time also he was admitted a member of the Royal Society; and in another journey in 1721, he contracted an intimacy with Martin Folkes, Esq. the president of it, which continued during his whole life,

In 1722, Lord Polworth, plenipotentiary of the King of Great Britain at the congress of Cambray, engaged Maclaurin to go as a tutor and companion to his eldest son, who was then to set out on his travels. After a short stay at Paris, and visiting other towns in France, they fixed in Lorrain, where he wrote his piece on the percussion of bodies, which gained him the prize of the Royal Academy of Sciences for the year 1724. But his pupil dying soon after at Montpelier, he returned immediately to his profession at Aberdeen. He was hardly settled here when he received an invitation to Edinburgh; the curators of that university being desirous that he should supply the place of Mr. James Gregory, whose great age and infirmities had rendered him incapable of teaching. He had here some difficulties to encounter, arising from competitors, who had good interest with the patrons of the university, and also from the want of an additional fund for the new professor; which, however, at length were all surmounted, principally by the means of Sir Isaac Newton. Accordingly, in November 1725, he was introduced into the university, as was at the same time his learned colleague and intimate friend, Dr. Alexander Munro, professor of anatomy. After this, the mathematical classes soon became very numerous, there being generally upwards of 100 stu-

dents attending his lectures every year; who being of different standings and proficiency, he was obliged to divide them into four or five classes, in each of which he employed a full hour every day, from the first of November to the first of June. In the junior class he taught the first six books of "Euclid's Elements," plane trigonometry, practical geometry, the elements of fortification, and an introduction to algebra. The second class studied algebra, with the eleventh and twelfth books of Euclid, spherical trigonometry, conic sections, and the general principles of astronomy. The third went on in astronomy and perspective, read a part of "Newton's Principia," and had performed a course of experiments for illustrating them; he afterwards read and demonstrated the elements of fluxions. Those in the fourth class read a system of fluxions, the doctrine of chances, and the remainder of "Newton's Principia."

In 1734, Dr. Berkley, Bishop of Cloyne, published a piece called the "Analyst;" in which he took occasion, from some disputes that had arisen concerning the grounds of the fluxionary method, to explode the method itself; and also to charge mathematicians in general with infidelity in religion. Maclaurin thought himself included in this charge, and began an answer to Berkley's book; but other answers coming out, and as he proceeded, so many discoveries, so many new theories and problems occurred to him, that instead of a vindicatory pamphlet, he produced a complete system of fluxions, with their application to the most considerable problems in geometry and natural philosophy. This work was published at Edinburgh in 1742, 2 vols. 4to.; and as it cost him infinite pains, so it is the most considerable of all his works, and will do him immortal honour, being indeed the most complete treatise on that science that has yet appeared.

In the mean time, he was continually obliging the public with some observation or performance of his own, several of which were published in the fifth and sixth volumes of the Medical Essays at Edinburgh. Many of them were likewise published in the Philos. Trans. as the following: 1. On the construction and measure of curves, vol. 30.—2. A new method of describing all kinds of curves, vol. 30.—3. On equations with impossible roots, vol. 34.—4. On the roots of equations, &c. vol. 34.—5. On the description of curve lines, vol. 39.—6. Continuation of the same, vol. 39.—7. Observations on a solar eclipse, vol. 40.—8. A rule for finding the meridional parts of a spheroid, with the same exactness as in a sphere, vol. 41.—9. An account of the treatise of fluxions, vol. 42.—10. On the basis of the cells, where the bees deposit their honey, vol. 42.

In the midst of these studies, he was always ready to lend his assistance in contriving and promoting any scheme which might contribute to the public service. When the Earl of Morton went, in 1739, to visit his estates in Orkney and Shetland, he requested Mr. Maclaurin to assist him in settling the geography of those countries, which is very erroneous in all our maps; to examine their natural history, to survey the coasts, and to take the measure of a degree of the meridian. Maclaurin's family affairs would not permit him to comply with this request; he drew up however a memorial of what he thought necessary to be observed, and furnished proper instruments for the work, recommending Mr. Short, the noted optician, as a fit operator for the management of them.

Mr. Maclaurin had still another scheme for the improvement of geography and navigation, of a more extensive nature; which was the opening a passage from Greenland to the South Sea by the north pole. That such a passage might be found, he was so fully persuaded, that he used to say, if his situation could admit of such adventures, he would undertake the voyage, even at his own charge. But when schemes for finding it were laid before the parliament in 1741, and he was consulted by several persons of high rank concerning them, and before he could finish the memorial he proposed to send, the premium was limited to the discovery of a north-west passage; and he used to regret that the word west was inserted, because he thought that passage, if at all to be found, must lie not far from the pole.

In 1745, having been very active in fortifying the city of Edinburgh against the rebel army, he was obliged to fly from thence into England, where he was invited by Dr. Herring, Archbishop of York, to reside with him during his stay in this country. In this expedition, however, being exposed to cold and hardships, and naturally of a weak and tender constitution, which had been much more enfeebled by close application to study, he laid the foundation of an illness which put an end to his life, in June 1746, at 48 years of age, leaving his widow with two sons and three daughters.

Mr. Maclaurin was a very good, as well as a very great man, and worthy of love as well as admiration. His peculiar merit as a philosopher was, that all his studies were accommodated to general utility; and we find, in many places of his works, an application, even of the most abstruse theories, to the perfecting of mechanical arts. For the same purpose he had resolved to compose a course of practical mathematics, and to rescue several useful branches of the science from the ill treatment they often met with in less skilful hands. These intentions however were prevented by his death; unless we may reckon, as a part of his intended work, the translation of Dr. David Gregory's Practical Geometry, which he revised, and published with additions, in 1745.

In his life-time, however, he had frequent opportunities of serving his friends and his country by his great skill. Whatever difficulty occurred concerning the constructing or perfecting of machines, the working of mines, the improving of manufactures, the conveying of water, or the execution of any public work, he was always ready to resolve it. He was employed to terminate some disputes of consequence that had arisen at Glasgow, concerning the gauging of vessels; and for that purpose presented to the commissioners of the excise two elaborate memorials, with their demonstrations, containing rules by which the officers now act. He made also calculations relating to the provision, now established by law, for the children and widows of the Scotch clergy, and of the professors in the universities, entitling them to certain annuities and sums, upon the voluntary annual payment of a certain sum by the incumbent. In contriving and adjusting this wise and useful scheme, he bestowed a great deal of labour, and contributed not a little towards bringing it to perfection.

Of his works, we have mentioned his "Geometrica Organica," in which he treats of the description of curve lines by continued motion; as also of his piece which gained the prize of the Royal Academy of Sciences in 1724. In 1740, he likewise shared the prize of the same academy, with the celebrated D. Bernoulli and Euler, for resolving the problem relating to the motion of the tides from the theory of gravity, a question which had been given out the former year without receiving any solution. He had only ten days to draw this paper up in, and could not find leisure to transcribe a fair copy; so that the Paris edition of it is incorrect. He afterwards revised the whole, and inserted it in his treatise of fluxions; as he did also the substance of the former piece. These, with the treatise of fluxions, and the pieces printed in the Medical Essays, and the Philos. Trans. a list of which is given above, are all the writings which our author lived to publish.

Since his death, however, two more volumes have appeared; his algebra, and his account of Sir Isaac Newton's philosophical discoveries. The algebra, though not finished by himself, is yet allowed to be excellent in its kind; containing, within a moderate compass, a complete elementary treatise of that science, as far as it has hitherto been carried; besides some neat analytical papers on curve lines. His account of Newton's philosophy was occasioned in the following manner. Sir Isaac dying in the beginning of 1728, his nephew, Mr. Conduitt, proposed to publish an account of his life, and desired Mr. Maclaurin's assistance. The latter, out of gratitude to his great benefactor, cheerfully undertook, and soon finished, the history of the progress which philosophy had made before Newton's time; and this was the first draught of the work in hand; which not going forward, on account of Mr. Conduitt's death, was returned to Mr. Maclaurin. To this he afterwards made great additions, and left it in the state in which it now appears. His main design seems to have been, to explain only those parts of Newton's philosophy which have been controverted; and this is supposed to be the reason why his grand discoveries concerning light and colours are but transiently and generally touched upon; for it is known, that whenever the experiments on which his doctrine of light and colours is founded had been repeated with due care, this doctrine had not been contested; while his accounting for the celestial motions, and the other great appearances of nature, from gravity, had been misunderstood, and even attempted to be ridiculed.

MACQUER (Joseph), in biography, an eminent chemist, was born at Paris in 1710. He was brought up to physic, and became a doctor of the faculty of medicine, in the university of Paris, professor of pharmacy, and censor royal. He was also a member of the academies of sciences of Turin, Stockholm, and Paris, and he held the medical and chemical departments in the Journal des Savans. M. Macquer made

himself well known by several useful and popular works on chemistry, of which science he was one of the most successful cultivators on the modern rational plan, before the new modelling which it has received of late years. His publications were "Elemens de Chymie Pratique," two vols. 12mo. 1751–1756. "Plan d'un Cours de Chymie experimentale et raisonnée," 12mo. 1757. This was drawn up in conjunction with M. Baumé, who lectured on chemistry in partnership with him; "Dictionnaire de Chymie," two vols. 8vo. 1766. These works have been translated into English and German: the dictionary, particularly by Mr. Keir, with great additions and improvements. He wrote likewise "Formulæ Medicamentorum Magistralium," 1763; and "L'Art de la Teinture de Soie," 1763; and he had a share in the "Pharmacopeia Parisiensis," of 1758. This meritorious writer died in 1784. Dict. Hist. de la Med. par Eloy. Nouv. Dict. Hist.

MACROCEPHALUS, in natural history, a genus of insects of the order Hemiptera: snout inflected; the sheath one-valved, three jointed, and furnished with three bristles; antennæ projecting, very short, submoniliform, clavate; head oblong, cylindrical above; scutel as long as the abdomen, depressed, membranaceous. There is only one species, viz. M. cimicoides, found in North America; the body is a ferruginous grey; scutel pale ash with a yellow rigid spot; under-wings purplish violet; fore-shanks thickened.

MACROCNEMUM, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Rubiaceæ, Jussieu. Essential character: corolla bell-shaped; capsule two-celled, two-valved, with the valves gaping outwardly at the sides; seeds imbricate. There are three species.

MACROLOBIUM, in botany, a genus of the Triandria Monogynia class and order. Natural order of Lomentaceæ. Leguminosæ, Jussieu. Essential character: calyx double, outer two-leaved, inner one-leaved; petals five, upper one very large, the rest small, equal; germ pedicelled, legume. There are three species, all of them tall trees, from sixty to eighty feet in height; they are natives of the large forests of Guiana.

MACROPUS, the *kanguroo*, in natural history, a genus of mammalia of the order Feræ. Generic character: six front teeth in the upper jaw, emarginated; two in the lower, and very long, sharp, large, and pointing forwards; five grinders on each side of the upper and under jaw, distant from the other teeth; fore-legs very short; hind ones very long; the female, with an abdominal pouch. This is one of the most curious of all the animals discovered on the continent of New South Wales, where it was observed by some of the sailors of Captain Cook in the year 1770. When full grown it weighs about 150 pounds. Its head somewhat resembles that of a deer, but is destitute of horns; its countenance is gentle and complacent; its colour is of a pale brown; its length from the nose to the tail is between four and five feet, and the length of the tail is about three feet. Its general position, when resting, is that of standing on its hind feet, on their whole extent to the knees, and its fore-feet are frequently employed, like those of the squirrel, as hands. They are often, however, laid on the ground, and the kanguroo is often seen in this posture, feeding. Vegetables, and particularly grass, constitute its only nourishment. In its rapid motions, however, the fore-feet are wholly useless, and it proceeds by leaping on its hind feet, which it will do to the distance of fourteen or sixteen feet, and with bounds so rapid in succession, that it exceeds in swiftness a common dog. Kanguroos possess the faculty of separating at pleasure the two front teeth of their lower jaw; and the female is furnished with a pouch in the abdomen, of extraordinary depth, in which are placed two teats. But one young one is produced at a time, which, when first observed in the pouch, after its birth, is scarcely more than an inch in length, but grows to a considerable size in this natural receptacle before it quits it, and frequently recurs to it for warmth and security after its first dislodgment from it. This animal is in this striking circumstance allied to the opossum genus, under which Gmelin ranks it, but it differs from the opossum materially in respect to the structure of the teeth. In its general appearance it strongly resembles the jerboa. It was the only quadruped which Australasia supplied to the English colonists for food. It has been not only imported into England, but has repeatedly bred in this country, and may be considered as now naturalized; and though not apparently convertible to any important service, exhibits a very interesting variety to the observer of nature. Many of these animals are kept in the royal premises at Kew,

where those unacquainted with their form and habits may be easily gratified by a sight of them in various stages of growth, and bounding before him with a vivacity and elasticity highly entertaining. See Mammalia, Plate IX. fig. 3.

MACTRA, in natural history, a genus of the Vermes Testacea class and order. Animal a tethys; shell bivalve, unequal sided, equivalve; middle tooth of the hinge complicated, with a small hollow on each side; lateral ones remote and inserted into each other. There are twenty-seven species.

MACULÆ, in astronomy, dark spots appearing on the luminous faces of the sun, moon, and even some of the planets; in which sense they stand contradistinguished from faculæ. See FACULÆ.

These spots are most numerous and easily observed in the sun. It is not uncommon to see them in various forms, magnitudes, and numbers, moving over the sun's disk. They were first of all discovered by astronomer Galileo, in the year 1610, soon after he had finished his new-invented telescope. It has been supposed that these spots adhere to, or float upon the surface of the sun, for the following reasons. 1. Many of them are observed to break out near the middle of the sun's disk; others to decay and vanish there, or at some distance from his limb. 2. Their apparent velocities are always greatest over the middle of the disk, and gradually slower from thence on each side towards the limb. 3. The shape of the spots varies according to their position on the several parts of the disk: those which are round and broad in the middle, grow oblong and slender as they approach the limb, according as they ought to appear by the rules of optics.

By comparing many observations of the intervals of time in which the spots made their revolution, by Galileo, Cassini, Scheiner, Hevelius, Dr. Halley, Dr. Derham, and others, it is found that 27 days, 12 hours, 20 minutes, is the measure of one of them at a mean; but in this time the earth describes the angular motion of $26^\circ\ 22'$, about the sun's centre: therefore say, as the angular motion of $360^\circ + 26^\circ\ 22'$, is to 360°; so is 27 days, 12 hours, 20 minutes, to 25 days, 15 hours, 16 minutes; which, therefore, is the time of the sun's revolution about its axis.

As to the magnitude of the spots, they are very considerable, as will appear if we observe that some of them are so large as to be plainly visible to the naked eye: thus Galileo saw one of them in the year 1612; and Mr. Martin assures us, that he knew two gentlemen that thus viewed them several years ago; whence he concludes, that these spots must therefore subtend, at least, an angle of one minute. Now the diameter of the earth, if removed to the sun, would subtend an angle of but $20''$; so that the diameter of a spot, just visible to the naked eye, is, to the diameter of the earth, as 60 to 20, or as 3 to 1; and, therefore, the surface of the spot, if circular, to a great circle of the earth, is as 9 to 1; but 4 great circles are equal to the earth's superficies; whence the surface of the spot is, to the surface of the earth, as 9 to 4; or as $2\frac{1}{4}$ to 1. Gassendus says, he saw a spot whose diameter was equal to $\frac{1}{20}$ of that of the sun, and therefore subtended an angle at the eye of $1'\ 30''$; its surface must have been five times larger than the surface of the whole earth. What these spots are, it is presumed, nobody can tell; but they seem to be rather thin substances than solid bodies, because they lose the appearance of solidity in going off the disk of the sun: they resemble something of the nature of scum or scoria, swimming on the surface, which are generated and dissolved by causes little known to us: but whatever these solar spots are, it is certain they are produced from causes very inconstant and irregular; for Scheiner says he frequently saw fifty at once, but for twenty years after scarce any appeared. And in the last century the spots were very frequent and numerous till the year 1741, when, for three years successively, very few appeared, and now, since the year 1744, they have again appeared as usual.

These maculæ are not peculiar to the sun, they have been observed in all the planets. Thus Venus was observed to have several by Signior Blanchini, in the year 1726. As in Venus, so in Mars, both dark and bright spots have been observed, first by Galileo, and afterwards by Cassini, &c. Jupiter has had his spots observable ever since the invention and use of large telescopes. Saturn, by reason of his great distance on one hand, and Mercury, by reason of his smallness and vicinity to the sun on the other, have not as yet had any spots discovered on their surfaces, and consequently nothing in relation to their diurnal motions and inclinations of their axis to the planes of their orbits can be known, which

circumstances are determined in all the other planets, as well as in the sun, by means of these maculæ.

The spots, or maculæ, observable on the moon's surface, seem to be only cavities or large caverns, on which the sun shining very obliquely, and touching only their upper edge with his light, the deeper places remain without light; but as the sun rises higher upon them, they receive more light, and the shadow, or dark parts, grow smaller and shorter, till the sun comes at last to shine directly upon them, and then the whole cavity will be illustrated: but the dark dusky spots, which continue always the same, are supposed to proceed from a kind of matter or soil which reflects less light than that of the other regions. See MOON.

MADDER is a plant, with rough narrow leaves, set in form of a star, at the joints of the stalk. The root, which is the only part made use of, is long, slender, of a red colour, both on the outside and within, excepting a whitish pith, which runs along the middle. For cultivating this plant, the ground is ploughed deep in autumn, and again in March; and then laid up in ridges, eighteen inches asunder, and about a foot high. About the beginning of April, they open the ground where old roots are planted, and take off all the side shoots, which extend themselves horizontally; these they transplant immediately upon the new ridges, at about a foot distance, where they remain two seasons; and at Michaelmas, when the tops of the plants are decayed, they take up the roots. It is to be observed, that this method of planting in ridges is only necessary in wet land, and that the rows are sometimes planted three feet, and the plants in the rows eighteen inches asunder. If all the horizontal roots are destroyed from time to time, it will cause the large, downright roots, to be much bigger, in which the goodness of this commodity chiefly consists. Madder gives out its colour, both to water and rectified spirit: the watery tincture is of a dark dull red; the spirituous of a deep bright one. It imparts to woollen cloth, prepared with alum and tartar, a very durable, though not a very beautiful red dye. As it is the cheapest of all the red drugs, that give a durable colour, it is the principal one commonly made use of for ordinary stuffs. Sometimes its dye is heightened by the addition of Brazil-wood, and sometimes it is employed in conjunction with the dearer reds, as cochineal; for demi-scarlets, and demi-crimsons.

MADREPORA, in natural history, a genus of the Vermes Zoophyta class and order. Animal resembling a medusa; coral with lamellate star-shaped cavities. This is a very numerous genus, comprehending about 120 species, separated into distinct divisions. A. composed of a single star. B. with numerous separate stars, and continued gills. C. with numerous united stars. D. aggregate, undivided, with distinct stars and porulous tuberculous prominent undulations. E. branched, with distinct stars and tuberculous porulous undulations. M. verrucaria, star orbicular, flattish, sessile, with a convex disk full of tubular pores and radiate border: it inhabits the European, Mediterranean, and Red Seas, adhering to marine vegetables and the softer zoophytes; size of a split-pea, and appears an intermediate species between the madrepore, tubipore, and millepore; white or yellowish, with aggregate tubes on the disk like the florets of a composite flower, and a flattened striate border like the rays of these flowers. A. ananas, with angular convex stars, which are concave on the disk, inhabits the Mediterranean and South American Sea, and is frequently found fossile; gibbous, and when dissected transversely, resembling a white net with hexangular spots, including a white ring, and striate between the net and ring. See ZOOPHYTA.

MADREPORITE, a mineral found in the valley of Russback, in Salzburg, and so called from its external resemblance to madrepore. It is found in large masses, is brittle and moderately heavy. Its component parts are,

Carbonate of lime	93.00
Carbonate of magnesia	0.50
Carbonate of iron	2.25
Charcoal	0.50
Silica	4.50
	99.75
Loss	25
	100

MADRIER, in the military art, a long and broad plank of wood, used for supporting the earth in mining and carrying on a sap, and in making coffers, caponiers, galleries, and for many other uses at a siege. Madriers are also used to cover the mouths of petards, after they are load-

ed, and are fixed with the petards to the gates or other places designed to be forced open.

MADRIGAL, in the Italian, Spanish, and French poetry, is a short amorous poem, composed of a number of free and unequal verses, neither confined to the regularity of a sonnet, nor to the point of an epigram, but only consisting of some tender and delicate thought, expressed with a beautiful, noble, and elegant simplicity. The madrigal is usually considered as the shortest of all the lesser kinds of poetry, except the epigram: it will admit of fewer verses than either the sonnet or the roundelay; no other rule is regarded in mingling the rhymes, and the different kinds of verse, but the fancy and convenience of the author: however, this poem allows of less licence than many others, both with respect to rhyme, measure, and delicacy of expression.

MAGAZINE, a place in which stores are kept, of arms, ammunition, provisions, &c. Every fortified town ought to be furnished with a large magazine, which should contain stores of all kinds, sufficient to enable the garrison and inhabitants to hold out a long siege, and in which smiths, carpenters, wheelwrights, &c. may be employed, in making every thing belonging to the artillery, as carriages, waggons, &c.

Magazine, *powder*, a place in which powder is kept in large quantities, and which, on account of the nature of the substance preserved, should be arched and bomb-proof. According to the plan of Vauban, they are sixty feet long and twenty-five broad in the inside. The foundations are eight or nine feet thick, and about as many feet high from the foundation to the spring of the arch. As some inconveniences have arisen from this structure, Dr. Hutton proposes to find an arch of equilibration, which he would have constructed to a span of twenty feet, the pitch being ten feet: the exterior walls at top forming an angle of 113°, and the height of the angular point above the top of the arch to be seven feet.

MAGGOT. See Musca.

MAGI, or Magians, an ancient religious sect in Persia, and other eastern countries, who maintained, that there were two principles, the one the cause of all good, the other the cause of all evil; and abominating the adoration of images, worshipped God only by fire, which they looked upon as the brightest and most glorious symbol of Oromasdes, or the good God; as darkness is the truest symbol of Arimanius, or the evil god. This religion was reformed by Zoroaster, who maintained that there was one supreme independent being; and under him two principles or angels, one the angel of goodness and light, and the other of evil and darkness: that there is a perpetual struggle between them, which shall last to the end of the world; that then the angel of darkness and his disciples shall go into a world of their own, where they shall be punished in everlasting darkness; and the angel of light and his disciples shall also go into a world of their own, where they shall be rewarded in everlasting light. The priests of the magi were the most skilful mathematicians and philosophers of the ages in which they lived, insomuch that a learned man and a magian became equivalent terms. The vulgar looked on their knowledge as more than natural, and imagined them inspired by some supernatural power; and hence those who practised wicked and mischievous arts, taking upon themselves the name of magians, drew on it that ill signification which the word magician now bears among us. This sect still subsists in Persia, under the denomination of gaurs, where they watch the sacred fire with the greatest care, and never suffer it to be extinguished. See Gaurs.

MAGIC, originally signified only the knowledge of the more sublime parts of philsosophy; but as the magi likewise professed astrology, divination, and sorcery, the term magi became odious, being used to signify an unlawful diabolical kind of science, acquired by the assistance of the devil and departed souls. See Astrology, Necromancy, &c.

Natural magic is only the application of natural philosophy to the production of surprising but yet natural effects. The common natural magic, found in books, gives us merely some childish and superstitious traditions of the sympathies and antipathies of things, or of their occult and peculiar properties; which are usually intermixed with many trifling experiments, admired rather for their disguise than for themselves.

Magic *lantern*. See Lantern.

Magic *square*, in arithmetic, a square figure made up of numbers in arithmetical proportion, so disposed in parallel and equal ranks, that the sums of each row, taken either perpendicularly, horizontally, or diagonally, are equal: thus,

Natural square.

1	2	3
4	5	6
7	8	9

Magic square.

2	7	6
9	5	1
4	3	8

Magic squares seem to have been so called, from their being used in the construction of talismans.

Take another instance ;

Natural square.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Magic square.

16	14	8	2	25
3	22	20	11	9
15	6	4	23	17
24	18	12	10	1
7	5	21	19	13

where every row and diagonal in the magic square makes just the sum 65, being the same as the two diagonals of the natural square.

It is probable that these magic squares were so called, both because of this property in them, viz. that the ranks in every direction make the same sum, appeared extremely surprising, especially in the more ignorant ages, when mathematics passed for magic, and because also of the superstitious operations they were employed in, as the construction of talismans, &c.; for, according to the childish philosophy of those days, which ascribed virtues to numbers, what might not be expected from numbers so seemingly wonderful? The magic square was held in great veneration among the Egyptians, and the Pythagoreans their disciples, who, to add more efficacy and virtue to this square, dedicated it to the then known seven planets divers ways, and engraved it upon a plate of the metal that was esteemed in sympathy with the planet. The square, thus dedicated, was inclosed by a regular polygon, inscribed in a circle, which was divided into as many equal parts as there were units in the side of the square; with the names of the angels of the planet, and the signs of the zodiac written upon the void spaces between the polygon and the circumference of the circumscribed circle. Such a talisman or metal they vainly imagined would, upon occasion, befriend the person who carried it about him. To Saturn they attributed the square of 9 places or cells, the side being 3, and the sum of the numbers in every row 15 : to Jupiter the square of 16 places, the side being 4, and the amount of each row 34 : to Mars the square of 25 places, the side being 5, and the amount of each row 65 : to the sun the square with 36 places, the side being 6, and the sum of each row 111 : to Venus the square of 49 places, the side being 7, and the amount of each row 175 : to Mercury the square with 64 places, the side being 8, and the sum of each row 260 : and to the moon the square of 81 places, the side being 9, and the amount of each row 369. Finally, they attributed to imperfect matter, the square with 4 divisions, having 2 for its side; and to God the square of only one cell, the side of which is also an unit, which multiplied by itself undergoes no change.

To form a magic square of an odd number of terms in the arithmetic progression 1, 2, 3, 4, &c. Place the least term 1 in the cell immediately under the middle or central one; and the rest of the terms, in their natural order, in a descending diagonal direction, till they run off either at the bottom, or on the side : when the number runs off at the bottom, carry it to the uppermost cell, that is not occupied, of the same column that it would have fallen in below, and then proceed descending diagonalwise again as far as you can, or till the numbers either run off at bottom or side, or are interrupted by coming at a cell already filled : now when any number runs off at the right-hand side, then bring it to the furthest cell on the left-hand of the same row or line it would have fallen in towards the right-hand: and when the progress diagonalwise is interrupted by meeting with a cell already occupied by some other number, then descend diagonally to the left from this cell till an empty one is met with, where enter it; and thence proceed as before. Thus,

To make a magic square of the 49 numbers 1, 2, 3, 4, &c.

22	47	16	41	10	35	4
5	23	48	17	42	11	29
30	6	24	49	18	36	12
13	31	7	25	43	19	37
38	14	32	1	26	44	20
21	39	8	33	2	27	45
46	15	40	9	34	3	28

First place the 1 next below the centre cell, and thence descend to the right till the 4 runs off at the bottom, which therefore carry to the top corner on the same column as it would have fallen in; but as that runs off at the side, bring it to the beginning of the second line, and thence descend to the right till they arrive at the cell occupied by 1; carry the 8 therefore to the next diagonal cell to the left, and so proceed till 10 runs off at the bottom, which carry therefore to the top of its column, and so proceed till 13 runs off at the side, which therefore bring to the beginning of the same line, and thence proceed till 15 arrives at the cell occupied by 8; from this therefore descend diagonally to the left; but as 16 runs off at the bottom, carry it to the top of its proper column, and thence descend till 21 runs off at the side, which is therefore brought to the beginning of its proper line; but as 22 arrives at the cell occupied by 15, descend diagonally to the left, which brings it into the first column, but off at the bottom, and therefore it is carried to the top of that column; thence descending till 29 runs off both at bottom and side, which therefore carry to the highest unoccupied cell in the last column; and here, as 30 runs off at the side, bring it to the beginning of its proper column, and thence descend till 35 runs off at the bottom, which therefore carry to the beginning or top of its own column; and here, as 36 meets with the cell occupied by 29, it is brought from thence diagonally to the left; thence descending, 38 runs off at the side, and therefore it is brought to the beginning of its proper line; thence descending 41 runs off at the bottom, which therefore is carried to the beginning or top of its column; from whence descending, 43 arrives at the cell occupied by 36, and therefore it is brought down from thence to the left; thence descending, 46 runs off at the side, which therefore is brought to the beginning of its line; but here, as 47 runs off at the bottom, it is carried to the beginning or top of its column, from whence descending with 48 and 49, the square is completed, the sum of every row and column and diagonal making just 175. Dr. Franklin carried this curious speculation further than any of his predecessors in the same way. He constructed both a magic square of squares, and a magic circle of circles, the description of which is as follows. The magic square of squares is formed by dividing the great square into 256 little squares, in which all the numbers from 1 to 256, or the square of 16, are placed, in 16 columns, which may be taken either horizontally or vertically. Their chief properties are as follow. 1. The sum of the 16 numbers in each column or row, vertical or horizontal, is 2056. 2. Every half column, vertical and horizontal, makes 1028, or just one half of the same sum 2056. 3. Half a diagonal ascending, added to half a diagonal descending, makes also the same sum 2056; taking these half diagonals from the ends of any side of the square to the middle of it; and so reckoning them either upward or downward, or sideways from right to left, or from left to right. 4. The same with all the parallels to the half diagonals, as many as can be drawn in the great square: for any two of them being directed upward and downward, from the place where they begin, to that where they end, their sums still make the same 2056. Also the same holds true downward and upward; as well as if taken sideways to the middle, and back to the same side again. Only one set of these half diagonals and their parallels, is drawn in the same square upward and downward; but another set may be drawn from any of the other three sides. 5. The four corner numbers in the great square added to the four central numbers in it, make 1028, the half sum of any vertical or horizontal column, which contains 16 numbers; and also equal to half a diagonal or its parallel. 6. If a square hole, equal in breadth to four of the little squares or cells, be cut in a paper, through which any of the 16 little cells in the great square may be seen, and the paper be laid upon the great square; the sum of all the 16 numbers, seen through the hole, is always equal to 2056, the sum of the 16 numbers in any horizontal or vertical column.

MAGISTERY, an old chemical term, very nearly synonymous with precipitate, but is now rarely used except in the following combinations: magistery of bismuth, which is the white oxide of this metal precipitated from the nitrous solution by the addition of water; magistery of sulphur, which is sulphur precipitated from its alkaline solution by an acid.

MAGNA *charta*. See LIBERTY.

MAGNESIA, in chemistry, an earth, the properties of which were not fully known till Dr. Black, about the middle of the last century, investigated its nature. In the pursuit, the Doctor was led to the important discovery of the carbonic acid

gas. Magnesia had, before his time, been frequently confounded with lime; he, however, by the most accurate experiments shewed that it possessed properties different from all the other earths. Although magnesia exists in great abundance in combination with other substances, it has never been found perfectly pure in nature. It is an ingredient in many fossils; and several of the salts, which it forms by combination with the acids, are found in mineral springs, and in the water of the ocean. From these combinations magnesia is obtained by different artificial processes. Mr. Murray mentions the sulphate of magnesia, or Epsom salt, as well adapted to this purpose. One part of this salt is to be dissolved in twenty of water, and the solution filtered; to this is added, while hot, a solution of pure potash or soda, as long as precipitation is produced. The alkali combines with the sulphuric acid, and the magnesia is separated: being insoluble in water, it falls down in white powder: it is then washed in water till the fluid comes off tasteless. This earth exists under the form of a white spongy powder, soft to the touch, without smell, and having a slightly bitter taste. Its specific gravity is 2.3. It slightly changes vegetable colours to a green. Magnesia, when quite pure, is infusible, though exposed to the most intense heat: even in the focus of the very powerful burning mirror, or in the heat excited by oxygen gas, it cannot be melted. When made into a paste with water it contracts like alumina, if exposed to a sudden heat. It is almost insoluble in water. There is no action between magnesia and hydrogen, or carbon, and very little between it and phosphorus. It combines readily with the acids, and with them forms neutral salts. Of these the greater number are soluble or crystallizible, and have a bitter taste. It does not enter into combination with the fixed alkalies, but in combination with some of the other earths, it is fusible by means of a very strong heat. With lime, in certain proportions, it forms a greenish yellow glass. It is much used in medicine as a gentle laxative, and as an absorbent to destroy acidity in the stomach. It is also employed to aid the solution of resinous and gummy substances, as camphor and opium in water. We shall notice only a few of its combinations.

Magnesia combines with sulphur either in the dry or humid way, forming thereby a sulphuret of magnesia. The solid sulphuret of magnesia decomposes rapidly when exposed to the air.

Sulphate of magnesia is a compound of sulphuric acid and magnesia, and is found in sea water, and in many mineral springs. Those at Epsom once afforded a large part of what was used in commerce, hence the name of Epsom salt. Now indeed it is commonly obtained from sea-water. The bittern water, or, as it is usually called the mother water of common salt, that is, the water which remains after the crystallization, consists chiefly of sulphate of magnesia. The constituent parts are, according to Bergman,

Sulphuric acid	33
Magnesia	19
Water	48
	100

But Mr. Kirwan gives a different result.

	In crystals.	Dry.
Sulphuric acid	29.35	63.32
Magnesia	17.00	36.68
Water	53.65	
	100	100

Sulphate of magnesia is formed by passing sulphurous acid through water, in which magnesia is diffused. At first it is in a state of powder, which is gradually dissolved, and by exposure to the air, it deposits crystals, and passes into sulphate of magnesia. It consists of

Sulphurous acid	39
Magnesia	16
Water	45
	100

Carbonate of magnesia, or the magnesia alba, of the physicians, is a very important compound. The manufacture of this on the large scale is thus conducted. Instead of the pure sulphate of magnesia, the bittern, or liquor remaining after the crystallization of sea salt is used, and the magnesia is precipitated by carbonate of potash. When properly prepared it is perfectly white, nearly or wholly tasteless, and very sparingly soluble in water. The magnesia of commerce is composed of

	Fourcroy.	Kirwan.
Carbonic acid	48	34
Magnesia	40	45
Water	12	21
	100	100

When common carbonate of magnesia is exposed to a moderate heat, it is decomposed: its carbonic acid disengaged. It loses about half its weight, and the magnesia remains nearly pure.

Under the magnesian genus of fossils are comprehended, not only those in which magnesia is the ingredient which is present in largest proportion, but those also in which, though in a smaller proportion, there exist the characters in some measure peculiar to this genus. These are softness, unctuosity, and being in general destitute of hardness, lustre, and transparency, which are conspicuous in many of those which belong to the silicious and argillaceous genera. Magnesian fossils have usually a green colour more or less deep.

MAGNET. See MAGNETISM.

MAGNETISM is supposed to have been first rendered useful about the end of the twelfth, or at least very early in the thirteenth century, by John de Gioja, a handicraft of Naples, who noticed the peculiar attraction of metals, iron in particular, towards certain masses of rude ore; the touch of which communicated to other substances of a ferruginous nature, especially iron or steel bars, the same property of attraction: these touched bars he observed to have a peculiar and similar tendency towards one particular point; that when suspended in equilibrio, by means of threads around their centres, they invariably indicated the same point; and that, when placed in a row, however adversely directed; they soon disposed themselves in perfectly parallel order. In this instance he improved upon the property long known to, but not comprehended or applied to use by the ancients, who considered the load-stone simply as a rude species of iron ore, and curious only so far as it might serve to amuse. Gioja being possessed of a quick understanding, and of a strong mind, was not long in further ascertaining the more sensible purposes to which the magnet might be appropriated. He accordingly fixed various magnets upon pivots, supporting their centres in such manner as allowed the bars to traverse freely. Finding that, however situated within the reach of observation and comparison, they all had the same tendency, he naturally concluded them to be governed by some attraction which might be ultimately ascertained and acted upon. He therefore removed into various parts of Italy, to satisfy himself whether or not the extraordinary impulse which agitated these bars that had been magnetised by friction, existed only in the vicinity of Naples, or was general. The result of his researches appears to be, that the influence was general, but that the magnets were rendered extremely variable, and fluctuated much, when near large masses of iron. The experiments of Gioja gave birth to many others, and at length to a trial of the magnetic influence on the surface of the water. To establish this, a vessel was moored out at sea, in a direction corresponding with that of the magnet; and a boat, having a magnet equipoised on a pivot at its centre, was sent out at night in the exact line indicated thereby; which, being duly followed, carried them close to the vessel that was at anchor. Thus the active power of attraction appeared to be established on both elements, and in the course of time the magnet was fixed to a card, marked with thirty-two points, whereby the mariner's compass was presented to us. The points to which the magnet always turned itself, being generally in correspondence with the meridian of the place where it acted, occasioned the extremities of the bars to be called poles. Succeeding experiments proved, that the magnetic bar never retained an exactly horizontal position; but that one of its poles invariably formed an angle with any perfect level, over which it was placed: this was not so very measurable in a short bar, but in one of a yard in length was found to give several degrees of inclination. This, which is called "The Dip of the Needle," (or magnet) seems to indicate that the attracting power is placed within the earth. What that attracting power is we cannot determine; some consider it to be a fluid, while others conjecture it to be an immense mass of load-stone situated somewhere about the north pole. The difficulty is, however, considerably increased by the known fact of the needles of compasses not always pointing due north; but in many places varying greatly from the meridional lines respectively; and from each other at different times and places. The facility with which a meridional line may be drawn by solar observation, and especially by taking an azimuth, fortunately enables navigators to establish the variation between the true northern direction, and that indicated by the magnet attached to the card of the compass. Nevertheless, we have great reason to believe, that, for want either of accurate knowledge of the prevalent varia-

tions, or from inattention thereto, many vessels, of which no tidings were ever heard, have been cast away; it being obvious that a false indication of the northern point, in many places amounting to nearly the extent of twenty-five degrees, must produce so important an error in a vessel's course, as to subject her to destruction on those very shoals, rocks, &c. which the navigator unhappily thinks he steers wide of. To obviate such danger, as far as possible, all modern sea-charts have the variations of the compass in their several parts duly noted down; and in reckoning upon the course steered by compass, an allowance is usually made for the difference between the apparent course, by the compass, and the real course, as ascertained by celestial observation. Under circumstances so completely contradictory, the principle of magnetism must remain unknown: we know not of any hypothesis which strikes conviction on our minds, or which seems to convey any adequate idea of the origin, or *modus operandi*, of this wondrous influence. All we can treat of is the effect; also of the appearances which guide our practice, and of the manner in which the attractive power may be generated and increased.

In regard to the latter point, namely, the generation and increase of the magnetic attraction, we shall endeavour to give a brief but distinct view of what relates thereto: observing that where volcanic eruptions are frequent, and in those latitudes where the aurora borealis is distinctly seen, the needle or magnet is sensibly affected. Previously to earthquakes, as well as during their action, and while the northern lights are in full display, no reliance can be placed on the compass; of which the card will appear much agitated. This has given rise to the opinion held by some, that the power is a fluid: to this, however, there appear so many objections, that we are more disposed to reject than to favour it, although under the necessity of confessing that we are not able to offer one that may account satisfactorily for the various phenomena attendant upon magnetism.

We have already stated, that every magnet has two poles; that is, one end is called the north, the other the south, pole: the former being considered as capable of attraction; the other, as we shall infer from the subjoined explanations, being far more inert, if at all possessed of an attractive power. When two magnets are brought together with their north poles in contact, they will, instead of cohering, be obviously repelled to a distance corresponding with their respective powers of attraction, when applied individually to unmagnetised needles. The south poles will, in like manner, repel each other; but the north pole of one, and the south pole of the other, will, when approximated, be evidently attracted, and will cohere so as to sustain considerable weights. Iron is the only metal, hitherto known, which is capable of receiving and communicating the magnetic power; but quiet, and the absence of contact, in some respects, are indispensably necessary towards its perfect retention. Thus, when a bar has been impregnated, however abundantly, with the magnetic principle, if it be heated or hammered, the power of attraction will be dissipated; or if a tube filled with iron filings have their surface magnetised, by shaking the tube the magnetic influence will likewise be lost. In some respects the magnetic influence resembles caloric; for it very rapidly communicates to iron, devoid of magnetism, a certain portion of its own powers; which, however, appear to be reproduced instantaneously. As various small fires under one large vessel will thereby heat it, and cause the water it contains to boil, though either of them individually would not produce that effect; so many weak magnets may, by causing each to communicate a power equal to its own, be made to create an accumulated power, larger than that contained by either of them individually: there is, however, a seeming contradiction to be found in some authors, who recommend that the weakest magnets should be first applied, and those more forcible in succession according to the power they may possess; the reason assigned being, that the weaker magnets would else, in all probability, draw off some of the accumulated power from the new magnet. Of this there appears no danger, since experience proves that magnets rather gain than lose efficiency by contact, not only with each other, but even with common iron. In fact, the magnetic power may at any time be created by various means: the friction of two pieces of flat and polished bars of iron will cause them for a short while to attract, and to suspend, light weights. Soft iron is more easily influenced, but steel will retain the influence longer. Lightning, electricity, and galvanism, being all of the same nature, equally render iron magnetic. It is also peculiar, that when two or more magnets are left for

any time with their several north poles in contact, the whole will be thereby weakened; whereas, by leaving a piece of common iron attached to a magnet, the latter will acquire strength. It is also well known that some pieces of steel quickly receive the magnetic influence, while others require considerable labour, and after all are scarcely impregnated. The oxide of iron cannot be impregnated, and those bars that have been so, when they become partially oxydized, lose their power. Hence we see the necessity of preserving the needles of compasses from rust.

Magnets have the power to act notwithstanding the intervention of substances in any degree porous between them, and the body to be acted upon: thus, if a needle be put on a sheet of paper, and a magnet be drawn under it, the needle will follow the course of the magnet. The peculiar affinity of the load-stone for iron is employed, with great success, by those who work in precious metals, for the separation of filings, &c. of iron from the smaller particles of gold, &c. A magnet being dipped into the vessel, in which the whole are blended, will attract all ferruginous particles.

To communicate the magnetic power to a needle, let it be placed horizontally, and with a magnet in each hand, let the north pole of one, and the south pole of the other be brought, obliquely, in contact over the centre of the needle; draw them asunder, taking care to press firmly, and preserving the same angle or inclination to the very ends of the needles, which should be supported by two magnets, whose ends ought to correspond in polarity with those of the needle. Observe to carry the magnets you press with clear away from the ends of the needle, at least a foot therefrom; repeat the friction in the same manner several times, perhaps six, eight, or ten times, and the needle will be permanently magnetized. As we have already stated, by using other magnets in succession, the powers of the needle will be proportionably increased. But no effect will result from the friction if the bars are rusty, or, indeed, not highly polished; their angles must be perfect, and their several sides and ends completely flat.

It is, perhaps, one of the most curious of the phenomena attendant upon this occult property, that the centre of every magnet is devoid of attraction; yet, that when a needle is placed in a line with a magnet, and within the influence of its pole, that needle also becomes magnetic; or, rather, a conductor, possessing a certain portion of attractive power: and it is no less extraordinary, that the magnet retains its power even in the exhausted receiver of an air-pump: this seems to be a formidable objection to its being influenced by any fluid. Perhaps the opinion entertained by many of our most popular lecturers on this subject, *viz.* that the earth itself is the great attractor, may be nearest the truth. We are the more supposed to incline towards such an hypothesis, knowing that, at the true magnetic equator, the needle does not dip; and from the well ascertained fact, that bars of iron, placed for a length of time exactly perpendicular, receive a strong magnetic power, their lower ends repelling the south, but attracting the north poles of magnets applied to them respectively. The direction of the dipping needle was ascertained by one Robert Norman, about 250 years ago. He suspended a small magnetic needle, by means of a fine thread around its centre, so as to balance perfectly, over a large magnet: the south pole of the former was instantly attracted by the north pole of the latter. He found that so long as the needle was held exactly centrical, at about two inches above the magnet, it remained horizontal; but so soon as withdrawn a little more towards one end than the other of the magnet, the equilibrium was destroyed, and that pole of the needle which was nearest to either pole of the magnet was instantly attracted, and pointed downwards thereto. By the magnetic equator, we mean a circle passing round the earth at right angles with the magnetic poles, which do not correspond with the geographical poles, as may be fully understood by the indications of all compasses to points differing from the latter; and as the indications of compasses vary so much both at different times and places, we may reasonably conclude, that the magnetic poles are not fixed. The variation of the dipping needle has not, in our latitude at least, varied more than half a degree since its depressive tendency was first discovered by Norman.

The suspension of Mahomet's body, in the temple where it was deposited, is supposed to have resulted entirely from magnetism, with which the Arabians were completely unacquainted.

MAGNETISM, *animal.* About 30 years ago, Father Hehl of Vienna, imposed on

his countrymen, and indeed on the greater part of the civilized world, a pretended mode of curing all kinds of disease by means of a sympathetic affection between the sick person and the operator. The remedy was supposed to depend upon the motions of the fingers, and the features of the latter; he placing himself immediately before the invalid, whose eyes were to be fixed on his, and performing a number of antic and unmeaning changes, accompanied by various grimaces, or inflections of the principal muscles of the visage. This rarely failed to excite a certain degree of apprehension in the mind of the sick; which, by creating a new action of the system, often frightened them into convalescence. That such effects may have been produced among the credulous and timid, we shall not controvert; but, on the other hand, it is asserted that numbers have been so far overcome with terror and fatigue, (for, like Dr. Sangrado, the operator was never satisfied while any strength to undergo the process remained) that consequences highly dangerous, and in some instances fatal, were induced. Notwithstanding the obvious folly of the pursuit, there were found many gentlemen of great respectability and talents among its followers; hence a certain degree of credit was established, and there were not wanting persons foolish enough to certify many cases, and to give a celebrity which was in a very short time found to be misapplied. It is a lamentable case, that, throughout the world, impositions of this nature are always tolerated long enough to answer the purposes of the fabricator, and to encourage others in similar deceptions. Our readers may recollect many instances of notorious character, among which the metallic-tractors, which were at one time asserted to be allied to metallic-magnetism, may, perhaps, serve as a proper illustration and proof.

MAGNIFYING, in philosophy, the making of objects appear larger than they would otherwise do; whence convex lenses, which have the power of doing this, are called magnifying glasses; and of such glasses are microscopes constructed.

MAGNITUDE, whatever is made up of parts locally extended, or that hath several dimensions; as a line, surface, solid. The apparent magnitude of a body is that measured by the visual angle, formed by rays drawn from its extremes to the centre of the eye; so that whatever things are seen under the same or equal angles, appear equal; and, *vice versa*. Mr. Maclaurin observes, that geometrical magnitudes may be usefully considered as generated or produced by motion. Thus, lines may be conceived as generated by the motion of points; surfaces, by the motion of lines; solids, by the motion of surfaces; angles may be supposed to be generated by the rotation of their sides. Geometrical magnitude is always understood to consist of parts; and to have no parts, or to have no magnitude, are considered as equivalent in this science. There is, however, no necessity for considering magnitude as made up of an infinite number of small parts; it is sufficient that no quantity can be supposed to be so small, but it may be conceived to be farther diminished: and it is obvious, that we are not to estimate the number of parts that may be conceived in a given magnitude, by those which, in particular determinate circumstances, may be actually perceived in it by sense, since a greater number of parts become sensible, by varying the circumstances in which it is perceived.

MAGNOLIA, in botany, so named in honour of Pierre Magnol, professor of medicine, and prefect of the botanic garden at Montpelier, a genus of the Polyandria Polygynia class and order. Natural order of Coadunatæ. Magnoliæ, Jussieu. Essential character: calyx three-leaved; petals nine: capsule one-celled, two-valved; seeds berried, pendulous. There are seven species; of which M. grandiflora, great laurel-leaved magnolia, or tulip tree, in the southern provinces of North America, grows to the height of eighty feet: the trunk is more than two feet in diameter; the leaves are nine or ten inches long, and three broad in the middle, of a thick consistence, resembling those of the common laurel, but much larger; of a lucid green, sessile, and placed without order on every side of the branches; continuing green all the year, falling off only as the branches extend, and the new leaves are produced. The flowers come out at the ends of the branches: they are large, and composed of eight or ten petals, which are narrow at the base, broad, rounded, and a little waved at their extremities; they are of a pure white colour, possessing an agreeable scent. The summers in England are not warm enough to bring the fruit to perfection. This fine tree is a native of Florida and Carolina, and, in common with many of the trees and plants of that coun-

try, is impatient of cold here, and difficult to keep in perfection, either abroad or housed.

MAHERNIA, in botany, a genus of the Pentandria Pentagynia class and order. Natural order of Columniferæ. Tiliaceæ, Jussieu. Essential character: calyx five-toothed; petals five; nectaries five, obcordate, placed under the filaments; capsule five-celled. There are three species, natives of the Cape of Good Hope.

MAHOGANY. The swietenia mahagoni, or mahogany tree, is a native of the warmest parts of America, and grows also in the island of Cuba, Jamaica, Hispaniola, and the Bahama islands. It abounded formerly in the low lands of Jamaica; but it is now found only on hills, and places difficult of access. This tree grows tall and straight, rising often sixty feet from the spur to the limbs; and is about four feet in diameter. The foliage is a beautiful deep green, and the appearance made by the whole tree very elegant. The flowers are of a reddish or saffron colour, and the fruit of an oval form, about the size of a turkey's egg. Some of them have reached to a monstrous size, exceeding one hundred feet in height. In felling these trees, the most beautiful part is commonly left behind. The negro workmen raise a scaffolding of four or five feet elevation from the ground, and hack up the trunk, which they cut into balks. The part below, extending to the root, is not only of larger diameter, but of a closer texture than the other parts, most elegantly diversified with shades or clouds, or dotted like ermine with spots: it takes the highest polish, with a singular lustre. This part is only to be come at by digging below the spur, to the depth of two or three feet, and cutting it through; which is so laborious an operation, that few attempt it, except they are curious in the choice of their wood, or to serve a particular purpose. The mahogany tree thrives in most soils; but varies in texture and grain, according to the nature of the soil. On rocks it is of a smaller size; but very hard and weighty, and of a close grain, and beautifully shaded; while the produce of the low and richer lands is observed to be more light and porous, of a paler colour, and open grain; and that of mixed soils to hold a medium between both. This constitutes the difference between the Jamaica wood and that which is collected from the coast of Cuba and the Spanish Main; the former is mostly found on rocky eminences; the latter is cut in swampy soils, near the sea coast. The superior value of the Jamaica wood, for beauty of colouring, firmness, and durability, may therefore be easily accounted for; and a large quantity of balks and planks is brought from the Spanish American coasts to Jamaica, to be shipped from thence to Great Britain. This wood is generally hard, takes a fine polish, and is found to answer better than any other sort in all kinds of cabinet ware. It is a very strong timber, and was frequently used as such in Jamaica in former times. It is said to be used sometimes in ship-building; a purpose for which it would be remarkably adapted, if not too costly; being very durable, capable of resisting gun-shots, and burying the shots without splintering.

MAHOMETANS, believers in the doctrines and divine mission of Mahomet, the celebrated warrior and pseudo-prophet of Arabia, who was born at Mecca in the year 571. The father of Mahomet was Abdollech, descended from the Korashites, tribes who had long enjoyed the regal dignity in Arabia. Notwithstanding the royal descent of the prophet, it appears that a variety of adverse circumstances concurred to render him, in the early part of his life, indigent and obscure. His father died before he was two years of age, and his mother when he was about eight; so that he was left in a manner destitute of subsistence, and his education in a great measure, if not altogether, neglected. After the death of his mother, he was committed to the care of his grandfather, who dying within a year afterwards, he was taken under the protection of his uncle Taleb, a merchant of some respectability. There are various accounts relative to the manner in which Mahomet first began to invent and propagate his new system of faith and worship. It appears, according to the Mahometan historians, that his pretended mission was revealed to him in a dream, in the fortieth year of his age. From that time, say his biographers, Mahomet, under the influence of a holy terror, devoted himself to a solitary life. He retired to a grotto in the mountain of Hira, which overlooks Mecca. He there passed his days and nights in fasting, prayer, and meditation. In the midst of one of these profound ecstasies, the angel Gabriel appeared to him, with the first chapter of the Koran, and commanded him to read. Mahomet replied, he was unable; upon which the angel repeatedly embraced him, and commanded him to read in the name of his

Creator. A few days after, praying upon the same mountain of Hira, Mahomet again saw the angel of the Lord, seated in the midst of the clouds on a glittering throne, with the second chapter of the Koran; and was addressed by him in the following words: "O thou who art covered with a celestial mantle, arise and preach!" Thus the angel Gabriel communicated, by command of the Eternal, to his prophet, in the twenty-three last years of his life, the whole book of the Koran, leaf by leaf, chapter by chapter. There are, however, different accounts respecting the portions or parcels in which the Koran was given to Mahomet. See ALCORAN.

During the first thirteen years of the prophet's mission he appears to have made very slow progress; but the last ten were employed with greater success. Finding that visions, ecstasies, revelations, and arguments did not succeed so rapidly as he could have wished in making proselytes, he determined to try the more powerful and adventurous inducements of coercion. After his flight from Mecca to Medina, which took place A. D. 622, and from which his followers compute their time, the prophet made rapid progress. Thousands flocked to his standard, and he soon convinced his enemies, that if they refused to admit the divinity of his mission, they should feel the weight of his arm. He declared, that God sent him into the world not only to teach his will, but to compel mankind to embrace it. "The word," said he, "is the key of heaven and hell; a drop of blood shed in the cause of God, or a night spent in arms, is of more avail than two months of fasting and prayer. Whosoever falls in battle, his sins are forgiven at the day of judgment; his wounds shall be resplendant as vermilion, and odoriferous as musk, the loss of his limbs shall be supplied by the wings of angels and cherubim." Who would not die to be acquitted at the bar of heaven? Who would not prefer a night in arms to a fast of two months? And what mortal but would prefer the odours of musk to the stench of plaisters or fœtid ointments; the wings of angels to the cumbrous appendages of human limbs? These representations were attended with the desired effect on the minds and conduct of the prophet's admirers. They assembled in numbers to fight for God and his prophet. Headed by a chieftain of invincible courage, attractive eloquence, and astonishing genius, guarded by angels (as they supposed), and enflamed by the holy fire of fanaticism, success attended almost all their engagements. Mahomet, thus elevated, formed the stupendous design of creating a new empire. Here again success crowned his efforts. His plan was executed with such intrepidity, that he died, A. D. 632, master of all Arabia, besides several adjacent provinces. It is not our business, nor will our limits admit of it, to account for the rapid progress of the Mahometan faith. We may, however, summarily state, as causes of the eastern prophet's success: the terror of his arms; the artful nature of his law, which offered such rewards to the faithful, and such punishments to the infidels, as were best suited to the luxuriant fancies of the Arabians; the plainness and simplicity of some of his doctrines; the adaptation of the duties which his law enjoined to the passions and appetites of mankind; the profound ignorance under which the Arabians, Syrians, Persians, and the greatest part of the eastern nations, then laboured; and, lastly, the dissentions and animosities that then ravaged the peace, and destroyed the union of the Christian sects, particularly the Greeks, Nestorians, Eutychians, and Monophysites, and which rendered the very name of Christianity odious to many. These are some of the causes which gave life and strength to the Mahometan religion in the east.

The religion of Mahomet is divided into two general parts: faith and practice. The fundamental article of the Mahometan creed is contained in this confession: THERE IS BUT ONE GOD, AND MAHOMET IS HIS PROPHET. Under these two propositions are comprehended six distinct branches: *viz.* belief in God; in his angels; in his scriptures; in his prophets; in the resurrection and judgment; and in God's absolute decrees, or predestination. They reckon five points relating to practice; *viz.* prayer with washings, &c.; alms; fasting; pilgrimage to Mecca; and circumcision. Mahomet admitted the divine mission of both Moses and of Jesus Christ. Dr. Jortin says, that Mahometism is a borrowed system, made up for the most part of Judaism and Christianity; and if it be considered, the same writer observes, in the most favourable point of view, might possibly be accounted a sort of Christian heresy. Ashmet Benabdalla, in his letter to Maurice, Prince of Orange, says, "The Lord Jesus Christ is held by us (Mahometans) to be a prophet, and the messenger of God, and our

lady, the virgin Mary, his mother, to be blessed of God, holy, who brought him forth, and conceived him miraculously by the almighty power of God."

The Mahometans are a superstitious people, and hence in their religion we find a prodigious number of rites, ceremonies, and observances: the principal of which are: circumcision, ablutions, fastings, pilgrimage, polygamy, marriage rites, mourning for the dead, funeral rites, and the observance of Friday as a Sabbath. In all these observances, &c. there is a mixture of Heathenism, Judaism, and Christianity. After the death of their prophet, the Mahometans were divided, like the Christians, into an incredible number of sects and parties, all of them, however, professing to adhere to the Koran as the rule and guide of their faith and practice; yet differing widely from each other in particular points of belief, relative to doctrine, practice, and ecclesiastical discipline. Those who wish to see the history and character of this extensive sect more particularly detailed, will do well to consult the following authors: Fabricius's "Delectus et Syllabus argument. pro veritate relig. Christianæ;" Boulainvillier's, Gagnier's, and Prideaux's Lives of Mahomet; Sale's English Translation of the Koran; to which may be added, Professor White's Sermons at the Bampton Lectures, and Millar's account of Mahomet in his "Propagation of Christianity," vol. i. c. 1.

MAIDEN, in ancient English customs, an instrument for beheading criminals. Of the use and form of this instrument Mr. Pennant gives the following account: "It seems to have been confined to the limits of the forest of Hardwick, or the eighteen towns and hamlets within its precincts. The time when this custom took place is unknown; whether Earl Warren, lord of this forest, might have established it among the sanguinary laws then in use against the invaders of the hunting rights, or whether it might not take place after the woollen manufacturers at Halifax began to gain strength, is uncertain. The last is very probable; for the wild country around the town was inhabited by a lawless set, whose depredations on the cloth-tenters might soon stifle the efforts of infant industry. For the protection of trade, and for the greater terror of offenders by speedy execution, this custom seems to have been established, so as at last to receive the force of law, which was, 'That if a felon be taken within the liberty of the forest of Hardwick, with goods stolen out, or within the said precincts, either hand-habend, back-berand, or confession'd, to the value of thirteen pence halfpenny, he shall, after three market days, or meeting days, within the town of Halifax, next after such his apprehension, and being condemned, be taken to the gibbet, and there have his head cut from his body.' The offender had always a fair trial: for as soon as he was taken, he was brought to the lord's bailiff at Halifax: he was then exposed on the three markets (which here were held thrice in a week), placed in the stocks, with the goods stolen on his back, or, if the theft was of the cattle kind, they were placed by him; and this was done both to strike terror into others, and to produce new informations against him. The bailiff then summoned four freeholders of each town within the forest to form a jury. The felon and prosecutors were brought face to face; and the goods, the cow or horse, or whatsoever was stolen produced. If he was found guilty he was remanded to prison, had a week's time allowed for preparation, and then was conveyed to this spot, where his head was struck off by this machine. I should have premised, that if the criminal, either after apprehension, or in the way to execution, should escape out of the limits of the forest (part being close to the town), the bailiff had no further power over him, but if he should be caught within the precincts at any time after, he was immediately executed on his former sentence.

"This privilege was very freely used during the reign of Elizabeth: the records before that time were lost. Twenty-five suffered in her reign, and at least twelve from 1623 to 1650; after which, I believe, the privilege was no more exerted.

"This machine of death is now destroyed; but I saw one of the same kind in a room under the parliament house at Edinburgh, where it was introduced by the regent Morton, who took a model of it as he passed through Halifax, and at length suffered by it himself. It is in form of a painter's easel, and about ten feet high: at four feet from the bottom is a cross bar, on which the felon lays his head, which is kept down by another placed above. In the inner edges of the frame are grooves; in these is placed a sharp axe, with a vast weight of lead, supported at the very summit with a peg: to that peg is fastened a cord, which the executioner cutting, the axe falls, and does the affair effectually, without suffering

the unhappy criminal to undergo a repetition of strokes, as has been the case in the common method. I must add, that if the sufferer is condemned for stealing a horse or a cow, the string is tied to the beast, which, on being whipped, pulls out the peg, and becomes the executioner." This apparatus is now in possession of the Scottish Antiquarian Society.

MAJESTY, a title given to kings, which frequently serves as a term of distinction.

MAIHEM, or MAIM, signifies a corporal wound or hurt by which a man loseth the use of any member.

By the old common law, castration was punished with death, and other members with the loss of member for member; but of latter days, maihem was punishable only by fine and imprisonment. If a man attack another with an intent to murder him, and he does not murder the man, but only maim him, the offence is nevertheless a capital felony within the statute 22 and 23 Charles II. c. 1, usually called the Coventry Act.

And by a late statute, 44 Geo. III. c. 58, if any person shall, either in England or Ireland, wilfully, maliciously, and unlawfully, shoot at any of his Majesty's subjects, or wilfully, maliciously, and unlawfully present any kind of loaded fire-arms at any one, and attempt to discharge the same at him, or wilfully, maliciously, and unlawfully stab or cut any of his Majesty's subjects, with intent in so doing, or by means thereof to murder or rob, or to maim, disfigure, or disable him, or with intent to do some other grievous bodily harm to him, or to obstruct, resist, or prevent the lawful apprehension and detainer of the person so stabbing or cutting, or of any of his accomplices, for any offence for which they may be liable to be detained, or shall wilfully, &c. administer poison with intent to murder, or to procure the miscarriage of any woman quick with child, he shall be guilty of felony, and suffer death. But in case of levelling fire-arms, or cutting and maiming as aforesaid, if it shall appear that if death had ensued, the party would not have been guilty of murder, then the defendant shall be acquitted.

A person who maims himself that he may have the more colour to beg, or that he may not be impressed, may be indicted and fined.

MAINPRIZE, a delivering a person to his friends, to be answerable for his appearance. It differs from bail, as the mainpernors cannot keep the party in custody, but must let him be at liberty till the day of his appearance.

MAINTENANCE, the unlawful taking in hand or upholding a cause of any person. It was formerly unlawful to assist any person in litigation, except as an attorney, advocate, kinsman, servant, or near relation out of charity. The late Judge Buller expressed serious doubts whether the law against maintenance was not obsolete.

MAJOR, in the art of war, the name of several officers of very different ranks and functions; as, 1. Major-general, the next officer to the lieutenant-general: his chief business is to receive the orders from the general, or in his absence from the lieutenant-general of the day; which he is to distribute to the brigade-majors, with whom he is to regulate the guards, convoys, and detachments. When there are two attacks at a siege, he commands that on the left. He ought to be well acquainted with the strength of each brigade, of each regiment in particular, and to have a list of all the field officers. In short, he is in the army, what a major is in a regiment. He is allowed an aid de camp, and has a serjeant and fifteen men for his guard. 2. Major of a brigade, the officer who receives the orders from the major-general, and afterwards delivers them to the adjutants of the regiments at the head of the brigade; where he takes and marches the detachments, &c. to the general rendezvous. He ought to be an expert captain, to know the state and condition of the brigade, and keep a roll of the colonels, lieutenant-colonels, majors, and adjutants. 3. Major of a regiment, the next officer to the lieutenant-colonel, generally promoted from the oldest captain. He is to take care that the regiment be well exercised, to see it march in good order, and to rally it in case of its being broke. He is the only officer among the foot that is allowed to be on horseback in time of action, that he may the more readily execute the colonel's orders, either in advancing or drawing off the regiment. 4. Major of a regiment of horse, is the first captain, who commands in the absence of the colonel. 5. Town-major, the third officer in a garrison, being next to the deputy-governor. He ought to understand fortification, and hath charge of the guards, rounds, patroles, &c. His business is also to take care that the soldiers arms are in good order; he likewise orders the gates to be opened and shut, and gives the governor

an account of all that passes within the place.

There are also drum-majors, &c. so called from their pre-eminence above others of the same denomination.

MAKING *up*, among distillers, the reducing spirits to a certain standard of strength, usually called proof, by the admixture of water; which should be either soft and clear river water, or spring water rendered soft by distillation.

MALACHITE, a mineral, the green carbonate of copper, found frequently crystallized in long slender needles; colour green, and the specific gravity about 3.6. It efferversces with nitric acid, and gives a blue colour to ammonia. It decrepitates and blackens before the blow-pipe. There are two varieties, the fibrous and the compact: the constituent parts are

Copper	58.0
Carbonic acid	18.0
Oxygen	12.5
Water	11.5
	100.0

MALACHRA, in botany, a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx common three-leaved, many-flowered, larger; arils five, one-seeded. There are five species, natives of America.

MALACHODENDRUM, in botany, a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx simple; germ pear-shaped, pentagonal; styles five; capsule five, one-seeded. There are two species, *viz.* M. ovatum, and M. corchoroides.

MALACOLITE, a mineral found in the silver mines in Sweden, and also in Norway. It is obtained massive and crystallized in six sided prisms. Specific gravity about 3.25. It consists of

Silica	53
Lime	20
Magnesia	19
Alumina	3
Oxide of iron, &c.	4
	99
Loss	1
	100

MALATES, in chemistry, salts formed by the union of the malic acid with different bases. These salts have not been fully investigated; but it has been ascertained that the malates of lime, barytes, and magnesia are very insoluble. The malates of potash, soda, and ammonia, are deliquescent. The malates of potash, soda, ammonia, lime, and barytes, may be formed by dissolving these alkalies in malic acid, and evaporating the solutions.

MALAXIS, in botany, a genus of the Gynandria Diandria class and order. Natural order of Orchideæ. Essential character: nectary one-leafed, concave, cordate, acuminate backwards, bifid in front, cherishing the gentials in the middle. There are two species, *viz.* M. spicata and M. umbelliflora, both natives of Jamaica.

MALE, among zoologists, that sex of animals which has the parts of generation without the body.

The term male has also, from some similitude to that sex in animals, been applied to several inanimate things: thus we say, a male-flower, a male-screw, &c.

MALIC *acid*, in chemistry, was discovered by Scheele about the year 1785. It is found in the juices of a great many fruits, and it derives its name from the circumstance of its being obtained in great abundance from the juice of apples, in which it exists ready formed. It is thus obtained: saturate the juice of apples with potash, and add to the solution acetate of lead till no more precipitation ensues. Wash the precipitate carefully with a sufficient quantity of water; then pour upon it diluted sulphuric acid till the mixture has a perfectly acid taste, without any of that sweetness which is perceptible as long as any lead remains dissolved in it; then separate the sulphate of lead, which has precipitated, by filtration, and there remains behind pure malic acid. The French chemists have ascertained that it may be obtained in the largest quantities from the juice of the sempervivum tectorum, where it exists abundantly combined with lime. Malic acid is very soluble in water, and decomposes spontaneously, by undergoing a kind of fermentation. It is composed of oxygen, hydrogen, and carbon. It combines with alkalies, earths, and metallic oxides, and forms MALATES, which see above.

Dr. Thomson has shewn in what the citric and malic acids agree, and in what they differ. The citric acid shoots into crystals; but the malic will not crystallize. The citrate of lime is almost insoluble in boiling water, but the malate of lime is easily soluble in that liquid. Malic acid precipitates mercury, lead, and silver from

the nitrous acid, and likewise the solution of gold when diluted with water; whereas the citric acid does not alter any of these solutions.

MALICE, a formed design of doing mischief to another. Malice is of two kinds; express or implied. Malice express, in cases of homicide, is, where one with a deliberate intention, evidenced by external circumstances, kills another. This intention may appear by lying in wait, antecedent menaces, former grudges, and concerted schemes to do one some bodily harm. Malice implied is various; as where one voluntarily kills another without any provocation, or where one wilfully poisons another; in such cases, the law implies malice, though no particular enmity can be proved. See HOMICIDE.

In this latter case, the act, if it is in itself necessarily injurious to another, implies malice. As to stab one is the best evidence of a design to injure him, because the act necessarily must injure him, and malice is but a design to injure; and if it really were an accidental injury, that must be shown from other circumstances which are generally to be proved on the part of the defendant. Malice being a design to injure, any injurious act implies malice, but in common speech it is more frequently applied to the continued workings of a long preconceived hatred and ill-will.

MALLEABLE, a property of metals, whereby they are capable of being extended under the hammer. See DUCTILITY and METAL.

MALLET, a kind of large wooden hammer, used by artificers who work with a chissel, as sculptors, masons, and stone-cutters, whose mallets are commonly round; and by joiners, carpenters, &c. who work with square-headed mallets.

MALLEUS, in anatomy, a bone of the ear, so called from its resemblance to a mallet, and in which is observed the head, the neck and handle, which is joined to the membrane of the tympanum.

MALOPE, in botany, a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx double, outer three-leaved; arils glomerate, one-seeded. There are two species, viz. M. malacoides, and M. parviflora, the former has greatly the appearance of mallow, but differs from it in having the cells collected into a button, somewhat like a blackberry? the bunches spread, and lie almost flat upon the ground, extending a foot or more each way. The flowers are produced singly upon long axillary peduncles, they are in shape and colour like those of mallow. It is a native of the meadows of Tuscany and of Barbary.

MALPIGHIA, in botany, so named in honour of Marcello Malpighi, professor of medicine at Bologna, a genus of the Decandria Trigynia class and order. Natural order of Trihilatæ. Malpighiæ, Jussieu. Essential character: calyx five-leaved, with melliferous pores on the outside at the base; petals five, roundish, with claws; berry one-celled, three-seeded. There are eighteen species, of which M. glabra, smooth-leaved Barbadoes cherry, usually grows to the height of sixteen or eighteen feet; leaves opposite, subsessile, acute, continuing all the year; flowers in axillary and terminating bunches; the pedicels have a single joint; calyx incurved with glands; petals subcordate; stigmas simple, with a little drop; fruit red, round, the size of a cherry. This tree grows plentifully in most of the islands in the West Indies; whether it is natural there or not is difficult to determine, for birds being fond of the fruit, they disperse the seeds every where in great abundance.

MALT, a term applied to grain which has been made to germinate artificially to a certain extent, after which the process is stopped by the application of heat. The barley is steeped in cold water for a period not less than forty hours, by which it increases in bulk and imbibes moisture, while at the same time a quantity of carbonic acid gas is emitted, and a part of the substance of the husk is dissolved. The weight of the barley is increased in the proportion of 147 to to 100, and the bulk is increased about one-fifth. When it is sufficiently steeped, the water is drained off, and the barley thrown out of the cistern upon the malt floor, where it is formed into a rectangular heap, called the couch, sixteen inches deep. In this state it remains about twenty-six hours. It is then turned by means of wooden shovels, and diminished a little in depth: this operation is repeated twice or thrice a day, and the grain is spread thinner and thinner, till at last its depth does not exceed a few inches. On the couch it absorbs oxygen from the atmosphere, which it converts into carbonic acid; the temperature gradually increases, and in about four days the grain is ten degrees hotter than the surrounding atmosphere. The grain now becomes moist, and exhales an agreeable odour; this is called the sweat-

ing. A small portion of alcohol appears to be volatilized at this period of the process. The chief business of the maltster is to keep the temperature from becoming excessive, which is done by turning. The temperature may vary from fifty-five to sixty-two degrees. At the period of sweating, the roots of the grains begin to appear, which increase in length till checked by turning the malt. In one day after the sprouting of the roots, the rudiments of the future stem, called acrospire by the maltster, may be seen to lengthen, and it is now time to stop the process. As the acrospire shoots along the grain, the appearance of the kernel, or mealy part of the corn, undergoes a considerable change. The glutinous and mucilaginous matter is taken up and removed, the colour becomes white, and the texture is so loose that it crumbles to powder between the fingers. The object of malting is to produce this change: when it is accomplished, which takes place as soon as the acrospire has come nearly to the end of the seed, the process is stopped by drying the malt upon the kiln. The malt is then cleaned to separate the small roots, which are considered as injurious. Barley by malting generally increases two or three per cent. in bulk, and loses about one-fifth of its weight.

MALTA, *knights of*. See KNIGHT.

MALTHA, in chemistry, called also *seawax*, is a solid substance found on the Lake Baikal in Siberia. It is white, melts when heated, and on cooling assumes the consistence of white cerate. It readily dissolves in alcohol, and in other respects it possesses the characters of a solid volatile oil.

MALVA, in botany, *mallow*, a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx double, outer three-leaved; capsules many, united in a depressed whorl, one-celled, one-seeded. There are thirty-four species, chiefly perennial herbaceous plants.

MAMALUKES, the name of a dynasty that reigned in Egypt. The Mamalukes were originally Turkish and Circassian slaves, bought of the Tartars by Melicsaleh, to the number of a thousand, whom he bred up to arms, and raised some to the principal offices of the empire. They killed Sultan Moadam, whom they succeeded.

Others say, that the Mamalukes were ordinarily chosen from among the Christian slaves, and that they were the same thing in a great measure with the Janissaries among the Turks. They never married; they first are said to have been brought from Circassia, and some have supposed that they began to reign about the year 869.

MAMMÆ, the breasts, in anatomy. See MAMMARY *gland*.

MAMMALIA, in natural history, the first class of animals in the Linnæan system: the animals in this class have lungs that respire alternately; jaws incumbent, covered; teeth usually within; teats lactiferous; organs of sense, tongue, nostrils, eyes, ears, and papillæ of the skin; covering, hair, which is scanty in warm climates, and scarcely any on aquatics; supporters, four feet, except in aquatics; and in most a tail; walk on the earth and speak. Such is the Linnæan account. They suckle their young by means of lactiferous teats, and hence the name mammalia. In structure they resemble man; most of them are quadrupeds, and with man inhabit the surface of the earth: a few of them exist in the ocean. There are seven orders, the characters of which are taken from the number, situation, and structure of the teeth. The names of the orders are

Belluæ,	Glires,
Brula,	Pecora,
Cete,	Primates,
Feræ,	

which see.

MAMMARY *gland*, in anatomy, is a glandular substance situated in the breast, and secreting the milk.

This gland, surrounded by cellular and adipous substance, and covered by the common integuments, constitutes the breast. It lies on the anterior surface of the pectoralis major muscle.

In men, and in young girls, these bodies are small; they enlarge in the female subject very considerably at the time of puberty, assuming an hemispherical shape, and pretty firm consistence, which, however, is lost as the subject advances in years, particularly in women who have suckled many children.

The skin of the breasts is white, and soft to the touch, except in the middle, where there is a portion of a reddish brown colour, called the areola. From the centre of this the nipple projects, in the form of a cylindrical prominence, with a rounded end, similar in colour to the areola, and covered, like that part, by a more delicate continuation of the skin, which is somewhat wrinkled and irregular on its surface. Both the areola and nipple are furnished

with numerous sebaceous glands, which may be clearly seen through the integuments. The matter which these secrete, preserves the parts from the excoriation which they would otherwise suffer from suckling. The mammary gland is composed of a vast congeries of small tubes, convoluted and accumulated on each other, and known by the technical names of tubuli lactiferi. These unite together, gradually forming larger and larger trunks, which approach from all sides towards the nipple. The trunks become very much contracted at the areola, and in this state pass through the nipple, to terminate on its surface by open orifices about fifteen in number, whose size is about sufficient to admit a hog's bristle. This structure can only be shewn during the period of suckling.

The use of the milk secreted in these glands, as a nutriment for the young animal, is known to every body. It is singular that they should exist in the male, where they never perform any office whatever; at least, except in very rare instances, where a fluid of a milky nature has been poured out from them.

MAMMEA, in botany, a genus of the Polygamia Monoecia, or Dioecia class and order. Natural order of Guttiferæ, Jussieu. Essential character: calyx one-leafed, two-parted; corolla four-petalled; berry very large, four-seeded. There is but one species, viz. M. americana, American mammee, which is a lofty, upright, handsome tree, with a thick spreading elegant head; it has a long tap root, which renders it difficult to transplant; the leaves are oval, quite entire, extremely shining, leathery, firm with parallel transverse streaks, on short petioles from five to eight inches in length; peduncles one-flowered, scattered over the stouter branches; flowers sweet, white, an inch and half in diameter; the calyx is often trifid, with a five-petalled corolla. It is a native of the Caribbee islands, and the neighbouring continent.

MAN. The natural history of man is yet in its infancy; insomuch that we cannot pretend to give any thing like a complete view of the subject. The description and arrangement of the various productions of the globe, have occupied numerous observers in all ages of the world; and every insect and plant of common occurrence has been described with minute accuracy, while the human subject alone has been almost entirely neglected. It is only of late that the natural history of man has begun to receive its due share of attention; and we shall venture to assert, that, whether we regard the intrinsic importance of the questions that arise, or merely advert to the pleasure of the research, no subject will be found more deserving of minute investigation. Much of the following sketch is derived from Blumenbach, "De Generis Humani Varietate Nativa." Ed. 3d, Götting. 1795; to which we refer the reader for more detailed information. He may also consult the "Decades Craniorum" of the same author; Camper "Traité des Differences Reelles," &c. 4to.; Buffon in his large work on "Natural History;" Hunter "Disp. Inaug. de Hominum Varietatibus, earumque Causis;" Zimmerman "Geographische Geschichte der Menschen, &c." and Ludwig "Grundriss der Naturgeschichte der Menschen—species."

The differences, which exist between inhabitants of different regions of the globe, both in bodily conformation and in the faculties of the mind, are so striking, that they must have attracted the notice even of superficial observers. There are two ways of explaining these: first, by referring the different races of men to different original families, according to which supposition they will form in the language of naturalists, different species; or we may suppose them all to have descended from one family, and account for the diversity which is observable in them, by the influence of physical and moral causes; in which case they will only form different varieties of the same species.

Before, however, we enter upon this discussion, it will be necessary to dispose of a previous question; viz. what are the characters which distinguish man from all other animals; those which constitute him a distinct genus? Several writers, who have pleased themselves with describing what they call a regular gradation or chain of beings, represent man only as a superior kind of monkey; and place the unfortunate African as the connecting link between the superior races of mankind and the orang-outang; they deny, in short, that he is generically distinguished from monkeys. Such an opinion might reasonably be expected from the slave-merchant who traffics in human blood, and from a West Indian Negro driver, who uses his fellow-creatures worse than brutes; but we should not think of finding it defended by the natural historian, and we shall not hesitate to assert, that it is as false philosophically, as the moral and

political consequences, to which it would lead, are shocking and detestable. We set out with this position; that man has numerous distinctive marks, by which, under every circumstance of roughness and uncivilization, and every variety of country and race, he is separated, at a broad and most clearly defined interval, from every other animal, even of those classes which, from their general resemblance to the human subject, have been called anthropo-morphous. We cannot, indeed, by any means coincide with those moderns, who have indulged their imagination in painting a certain continuity or gradation of created beings; and who fancy they have discovered great wisdom of the Creator, and great perfection of the creation, in this respect; that nature makes no leaps, but has connected the various objects of the three kingdoms with each other, like the steps of a staircase, or the links of a chain. The candid and unprejudiced observer must allow, that in the animal kingdom there are whole classes, as birds, and particular genera, as the cuttle-fish, which cannot find a place in such a scheme of arrangement, without a very forced and unnatural introduction: and again, that there are certain genera, as the coccus, where the two sexes are so different from each other, that the male and female must be separated, and occupy different parts of the scale, in this artificial plan of gradation.

It is frequently easier to perceive, as it were intuitively, the distinctive characters of two neighbouring species of animals, than to express them by words. Hence Linnæus, whose sagacity in perceiving the characteristic marks of the various objects of natural history, and in expressing them in appropriate language, has never been exceeded, declares in his "Systema Naturæ," that the distinctions between man and the monkey still remain to be discovered: "Mirum, adeo parum differre stuttissimam simiam a sapientissimo homine, ut iste geodætes naturæ etiamnum quærendus, qui hos limitet." Accordingly, he gives neither the generic nor specific character of man in that work.

The circumstances which distinguish man from other animals may be considered under three divisions: 1. Differences in the structure of the body; 2. in the animal economy; 3. In the faculties of the mind.

Under the first head we remark, as the most distinguishing peculiarity of man, his erect stature: that majestic attitude, which announces his superiority over all the other inhabitants of the globe. He is the only being adapted by his natural formation to the upright position. Enslaved to their senses, and partaking merely of physical enjoyments, other animals have the head directed towards the earth: "quæ natura prona atque ventri obedientia finxit." Man, whose more elevated nature is connected to surrounding objects by moral relations, who can embrace in his mind the system of the universe, and follow the connections of effects and causes, boldly regards the heavens, and can direct his sight even into the starry regions. The physical cause of this noble prerogative will be found in the length and breadth of the feet; in the length and strength of the lower extremities, and in the number and size of the muscles, which extend the trunk upon the lower limbs. (For a more detailed account of this part of the subject, see COMPARATIVE ANATOMY, *muscles*).

The situation of the great occipital foramen is another circumstance depending on the erect stature of man: and for an account of this subject we refer to the same part of the article on comparative anatomy, and also to that portion of it which treats of comparative osteology.

The structure of the thorax shews, that man was not designed to go on all-fours. Quadrupeds, if they have long legs, have the chest flattened at the sides, and keel-shaped in front; and they have no clavicles, so that the front legs converge, and fall under the chest to support the front of the body. Quadrupeds have also a longer sternum, or a greater number of ribs continued towards the crista ilii, and serving the purpose of supporting the abdominal viscera in the horizontal position of the trunk. These things are all differently arranged in the biped man. His thorax is flattened before and behind; his shoulders widely separated from each other by the clavicles; his sternum short, and his abdomen unfurnished with bony parietes in a very large extent. These circumstances, with many others, which could not fail to strike any body who attentively compared the human skeleton with that of the long-legged quadrupeds, shew how ill the human structure is adapted to progression on four feet, which could not be otherwise than unsteady, troublesome, and fatiguing in the highest degree.

The manner in which the human pelvis differs from that of all other animals, is a further proof of what has been already

stated. The broad expansion of the upper part of the ilia forms a firm basis for the trunk; the curvature of the sacrum, and the inclination of the os coccygis forwards, which is a circumstance altogether peculiar to the human pelvis, give to it a capacity exceeding that of any other animal. In the orang-outang the upper part of the ilium is narrow and elongated, stretching upwards in the direction of the spine; the sacrum flat and contracted continues in a straight line with the vertebral column.

The relation of the neighbouring soft parts to the pelvis, deserves also to be considered. The posterior surface of the pelvis gives origin to the glutæi muscles, the external of which, exceeding in size all others in the body, and covered by a large proportion of fat, form the buttocks. These fleshy and rounded prominences, between which the anus is deeply hidden, have always been considered, both by the natural historian and the physiologist, as a peculiar characteristic of man, particularly distinguishing him from the simiæ, which have no buttocks at all.

The curvature of the sacrum and os coccygis gives rise to the particular direction of the organs of generation, and especially of the vagina; that canal, which, in the other female mammalia, nearly follows the axis of the pelvis, being placed almost at right angles to that axis in the woman; and hence the process of parturition becomes more difficult. In consequence of this direction of the vagina, the human female is not like that of brutes, retromingent: and the same circumstance will determine a point that has been often agitated, concerning the most natural position for the act of copulation: "quibus ipsa modis tractetur blanda voluptas." For although there are many ways in which this rite may be performed, the relation of the penis to the vagina points out the ordinary method as the most natural.

From the erect stature of man arises another very distinguishing prerogative; the most unconstrained use of his very perfect hands. So greatly does the conformation of these parts excel that of other animals, that Anaxagoras was hence induced to make an observation, which Helvetius has again brought forwards in our times; "that man is the wisest of animals, because he possesses hands." This indeed is too much; yet Aristotle is well justified in observing, that man alone possesses hands really deserving that name. The chief and most distinguishing part of the hand, viz. the thumb, is short, slender, and weak, even in the most anthropo-morphous simiæ; so that no other hand, but that of the human subject, deserves the name given to it by the Stagyrite, of the organ of all organs. (See the remarks on this subject in the article COMPARATIVE ANATOMY.)

The monkeys, apes, and other anthropomorphous animals can, in fact, be called neither bipeds nor quadrupeds; but they are quadrumanous, or four-handed. Their posterior limbs are furnished with a thumb, instead of a great toe; which latter part belongs only to man, and arises from the manner in which his body is supported in the erect position. Hence the dispute concerning the mode of progression of the orang-outang and other simiæ; viz. whether they go on all fours, or are supported by the posterior limbs only, will be easily settled. Neither of these representations is correct. Since the hands of these animals are not formed for walking, but for seizing and holding objects, it is clear that nature has designed them to live chiefly in trees. They climb these, and seek their food in them; and one pair of hands is employed in fixing and supporting the body, while the other gathers their food, or serves for other offices. Hence some, who have less perfect hands, are furnished with a prehensile tail, by which they can be more securely supported in trees.

It is hardly necessary to add, that when we see monkeys walking erect, it is to be ascribed to instruction and discipline. The delineations of the orang outang, taken accurately from the life, shew how inconvenient and unnatural the erect posture is to these animals: they are drawn with the front hands leaning on a stick, while the posterior ones are gathered up into the appearance of a fist. No instance has ever been produced of a monkey, nor of any other animal, except man, which could preserve his body in a state of equilibrium, when standing on one foot only. All these considerations render it very clear, that the erect stature not only arises out of the structure and conformation of the human body, but also that it is peculiar to man: and that the differences in the form and arrangement of parts, derived from this source only, are abundantly sufficient to distinguish man by a wide interval from other animals.

The hymen, a part for which no rational use has been hitherto assigned, is peculiar

to man; but the nymphæ and clitoris, of which the same assertion has been made, are found also in other animals.

The want of the os intermaxillare has generally been considered as characteristic of the human species. (See COMPARATIVE ANATOMY; *osteology.)*

The teeth of man are distinguished by the circumstance of their being arranged in an uniform, unbroken series. The lower incisors are placed perpendicularly; and the cuspidati neither project beyond the others, nor are separated from them by any interval. The molares are clearly distinguished by their obtuse prominence from those of all the simiæ. The lower jaw is remarkable for three reasons; its shortness, the projection of the chin, and the form and direction of the condyles, as well as the mode of their articulation with the basis cranii; which manifestly point out man as formed by nature to be an omnivorous animal.

In the brain we meet with a very striking difference between man and other animals. The human subject has the largest brain, not in proportion to the rest of the body, but to the size of the nerves, which proceed from it. Hence, if we divide the nervous system into two parts, one consisting of the nerves, and that part of the brain from which they arise, which is to be considered as appropriated to the functions of a mere animal life; the other, comprehending the remainder of the brain, and connecting the functions of the nerves with the faculties of the mind, man will possess the greatest proportion of the latter more important part. (See COMPARATIVE ANATOMY.)

Soemmerring has also shewn, that the calcareous matter of the pineal gland does not exist in any animal but man.

The smoothness of the human integuments, and the want of the hairy covering which other mammalia possess, must be considered as a peculiarity of man. The unanimous reports of all travellers prove beyond a doubt that every species of simia is hairy, and vastly more so than any man: although we read of instances of particularly hairy people, as in some of the South Sea islands; but the descriptions hitherto given are not completely satisfactory. While man is remarkable on the whole for the smoothness of his skin, some parts of his body are even more hairy than those of brutes; as the pubes and axilla.

The orang-outang, which resembles man more than any other simia, has a rib more on each side than the human subject; its sacrum consists of three pieces of bone, instead of five; and it has a peculiar membranous pouch, conected with the larynx.

Under the head of the animal economy, we may observe, as characteristic of man, the long period of infancy, and consequently late arrival at the age of puberty; the menstrual discharge in the female; and the celebration of the rites of Venus at all times of the year. No other of the class mammalia has the cranium consolidated, nor the teeth appearing at so late an age; none is so late in gaining the power of supporting the body on its limbs, in acquiring the full growth; nor in arriving at the exercise of the sexual functions. To none is there allotted such a length of life, compared with the bulk of the body; and this extension of existence, at its latter part, must be regarded as an ample compensation for the greater length of infancy. But it is in the mind, that nobler part of man, that we find him most remarkably differing from the brute creation. And here all philosophers refer, with one accord, to the enjoyment of reason, as the chief and most important prerogative of the human subject. If we enquire, however, more particularly into the meaning of this word, we shall be surprized to find what various senses different individuals affix to the same expression. According to some, reason is a peculiar faculty of the mind, belonging exclusively to man: others consider it as a more enlarged and exquisite developement of a power, which exists in a less degree in other animals. Some describe it as the combination of all the higher faculties of the mind; while others assert, that it is only a peculiar direction of the powers of the human mind, &c.

The subject may perhaps be more shortly and safely dispatched by considering it *a posteriori*; and placing the prerogative of man in the circumstance of his having brought all other animals under subjection to himself. That he has effected this is obvious; and it is equally clear, that his dominion has not been acquired by superior bodily strength: it can therefore only be referred to the powers of his mind; and to these, whatever be their nature, we give the name of reason. Man is designed to use all kinds of food; and to inhabit every climate of the globe. The unlimited power which he possesses in these respects, gives rise to various wants, from the infinite variety of climate, soil, and other circum-

stances. Man receives therefore from his Creator the power of invention and reason, which supply his wants. Hence, in the most ancient times, and by the wisest nations, the genius of invention has been honoured with divine worship: it forms the Thoth of the Egyptians, the Hermes of the Greeks. Thus, to give a few instances: man has made tools for assisting his labour; and hence Franklin sagaciously defined man as a "tool-making animal:" he has formed arms and weapons; he has devised various means of procuring fire; and lastly, for the purpose of communicating with his fellows, he has invented speech. This is to be accounted a most important characteristic of man; since it is not born with him, like the voices of animals, but has been framed and brought into use by himself, as the arbitrary variety of different languages incontestibly proves.

There is some doubt with respect to laughing and weeping; which belong rather to the passions than to reason. It is well known, that many animals besides man secrete tears. But the question is, do they weep from grief? The fact has been asserted by some great men; as by Steller, of the seal; and Pallas, of the camel. But it is very doubtful, whether they ever manifest cheerfulness by laughing.

There are numerous diseases peculiar to the human subject, which it might be considered wrong to speak of in remarks on the natural history of man; yet these unnatural phenomena undoubtedly deserve a place in the discussion, since they arise out of the natural habits of the body. The subject is obscure; since the nosology of brutes is exposed, by its very nature, to the most serious and almost insuperable difficulties. The following may however be considered, with all probability, as diseases peculiar to man: small-pox, measles, scarlatina, petechiæ, plague, hemorrhoids, menorrhagia, hypochondriasis, hysteria, the various affections of the mind, scrofula?, lues venerea, pellagra, lepra, amenorrhœa, cancer?, hernia congenita?, tinea capitis. These, though by no means all, are the chief points of difference between man and other animals: they have been enumerated, we can hardly say considered, in a very cursory manner; otherwise they would have afforded matter for a lengthened disquisition. The peculiarities appear abundantly sufficient to characterise man as a distinct genus; and consequently to overturn the wild chimeras of those visionary speculators, who regard him, in some of his races and modifications only as an improved orang-outang.

Our next point is the consideration of the varieties of the human species and their causes. This disquisition will perhaps appear superfluous to the devout believer, whose philosophy on this point will be derived from the writings composed with the assistance of divine inspiration, and therefore commanding our implicit assent. The account of the creation of the human race, and of its dispersion over the face of the globe, contained in the book of Genesis, will supersede in his mind the necessity of having recourse to any argument on the subject. We shall venture to submit that the Mosaic account does not make it quite clear that the inhabitants of all the world descended from Adam and Eve: we are told indeed, that "Adam called his wife's name Eve, because she was the mother of all living." But in the first chapter of Genesis we learn, that God created man, male and female; and this seems to have been previously to the formation of Eve, which did not take place until after the garden of Eden had been made. Again, we are informed in the fifth chapter of Genesis, that "in the day that God created man, in the likeness of God made he him; male and female created he them; and blessed them, and called their name Adam, in the day when they were created." We find also that Cain, after slaying his brother, was married, although it does not appear that Eve had produced any daughters before this time. It appears therefore that the field is open for discussion on this subject; and at all events, if the descent of mankind from one stock can be proved independently of the holy writings, the conclusion will establish the authority of these inspired annals.

If we fail in tracing the succession of the human race from above downwards, much less are we able to trace back any particular tribe to their first origin from the present stock. To use the words of an elegant modern historian; "neither the annals nor traditions of nations reach back to those remote ages, in which the different descendents of the first pair took possession of the different countries where they are now settled. We cannot trace the branches of this first family, nor point out with certainty the time and manner in which they divided and spread over the face of the globe. Even among the most enlightened people the period of authentic history is ex-

tremely short, and every thing prior to that is fabulous and obscure." We must therefore, in tracing the variations from the original stock, assign those causes, which are well known to have great influence on mankind, as climate, manner of life, state of society, &c.; occasionally deriving assistance from the analogies which are to be met with in the natural history of other animals.

Before we proceed to describe the varieties of the human race, it is necessary to consider, what constitutes a species in zoology; and how varieties arise out of species.

We should answer, in the abstract, to the first question; that all animals belong to the same species, which differ in such points only, as might arise in the natural course of degeneration, while those differences, which could not be explained on this supposition, would lead us to class the animals, which exhibit them in different species. But the great difficulty arises, in distinguishing in actual practice mere varieties from specific differences.

Ray, and after him Buffon, referred those animals to the same species, which copulate together, and produce a fertile offspring. But this criterion has produced very little benefit; and we probably must be contented to derive our notions of species in zoology from analogy and probability. The molar teeth of the Asiatic and African elephants differ very widely in their conformation; and, as we know no instance of such a difference produced by mere degeneration, we ascribe those animals to species originally different. The white ferret on the contrary we regard as a variety, because we know that the colour of the hair and pupil experiences a similar variation in other instances where it is a mere variety.

In considering the causes by the operation of which species degenerate into varieties, we shall be contented with stating the facts which prove the influence of such causes; without attempting to explain how they produce their effects. As there is very little of a satisfactory nature ascertained respecting this matter, we should be afraid of disgusting the sensible reader by substituting speculation in the place of more solid information.

A very slight consideration will shew that there is no point of difference between the several races of mankind, which has not been found to arise, in at least an equal degree, among other animals, as a mere variety, from the usual causes of degeneration. The instances of this kind are derived chiefly from domesticated animals, as they are exposed to all those causes which can produce such effects; by living with man they lead an artificial and unnatural kind of life, and are taken with him into climates and situations, and exposed to various other circumstances altogether different from their original destination; hence they run into numerous varieties of colour, form, size, &c. which, when they are established as permanent breeds, would be considered by a person uninformed on these subjects, to be originally different species. Wild animals on the contrary remaining constantly in the state for which they were originally framed, retain permanently their first character. Man, the inhabitant of every climate and soil, partaking of every kind of food, and of every variety in mode of life, must be exposed still more than any animal to the causes of degeneration.

Climate is one of the causes which seems to exercise a powerful influence on the animal economy, and the formation of the body. To this we must ascribe the white colour of several animals in the northern regions, which possess other colours in more temperate countries, *viz.* the fox, hare, falcon, crow, blackbird, &c. That this whiteness must be ascribed to the cold of the climate is rendered probable by the analogy of those animals which change their colour in the same country at the winter season to white or grey: as the ermine and weasel, hare, squirrel, reindeer, &c. &c. The common bear is very differently coloured in different countries. The remarkable silky and white covering of various animals in that district of Asia Minor called Angora must be explained in the same way, rather than from any difference of food; because it occurs in instances where very different kinds of food are used, as in the cat and goat. Hence also we account for the peculiar blackness of the fowls and dogs on the coast of Guinea, and for the change of the woolly covering of the sheep into hair in the same situation.

The effect of climate on the stature of the body is shewn by the smallness of the horses in Scotland and North Wales; and by the remarkable differences in this respect in the different provinces of Sweden. Must we not also explain on the same principle the constant and remarkable degeneracy of the horse in France? According to Buffon, the Spanish or Barbary horses, where the breed

is not crossed, degenerate into French horses in the second, or at latest in the third generation.

The effect of *food* on the body is very obvious in the well known fact of several singing birds, chiefly of the lark and finch kinds, becoming gradually black, if they are fed on hemp-seed only. The texture of the hair has been changed, in an African sheep brought into England, from the coarse nature of that of the camel, to considerable softness and fineness, by one year's feeding in the pastures of this country. The influence of the same cause on the stature and proportions of the body is shewn in the horse, which grows to a large size in the marshy grounds of Friesland, while on stony soils or dry heaths they remain dwarfish. Oxen become very large and fat in rich soils, but are distinguished by shortness of the leg; while in drier situations their whole bulk is much less, and the limbs are stronger and more fleshy. I do not advert to the well-known differences of flavour and weight produced by different food.

Manner of life. Under this head we include all these causes, which can act on the animal economy besides climate and food; and which, by their long continued influence on the body, effect considerable changes in it. Culture and the power of habit are the most efficacious of these, and exert a very powerful and indisputable action on our domestic animals. Observe the striking difference of form and proportion between the horse trained in the manege, and the wild, untaught, and unbroken animal. The latter bites rather than kicks; while the former, reined, and armed with iron shoes, uses these as his means of offence. The ass in its wild state is remarkably swift and lively, and still remains so in his native countries in the east. The argali, or wild original of the sheep, is covered with hair instead of wool; and the bison, or wild ox, has a long flowing mane, hanging almost to the ground. Most of the mammalia, which have been tamed by man, betray their subjugated state, by having the ears and tail pendulous. In many the very functions of the body, as the secretions, generation, &c. are greatly changed. The domestic sow produces young twice a year, and the wild animal only once.

The domestic pig acquires a vast accumulation of fat under the skin, which is never seen in the wild animal, which on the contrary possesses a soft downy hair among its bristles, speedily lost in the tamed individuals. The domesticated animals become liable to produce monstrous fetuses, and are exposed to new and numerous diseases: their bodies are even invaded by new kinds of worms, of which the hydatids in swine, forming what is commonly called the measles, are an indubitable instance.

The three causes now mentioned produce their effect in changing the original character of the animal, and giving origin to a variety, only after a great length of time, and a continued action through several generations. But these changes are communicated much more quickly by the process of generation. When two varieties copulate together the offspring resembles neither parent wholly, but partakes of the form and other peculiarities of both. This cannot with propriety be termed hybrid generation; as authors apply that expression to the produce of the copulation of different species, as of the horse and ass, &c. In this sense hybrids are never produced in the human species: for although we read various instances of men and women having commerce with animals, there is not a shadow of reason for supposing that such copulations ever produced an offspring. Breeding from different varieties has a great effect in changing the colour and form of the animal produced; and hence this method of improving and ennobling the race is practised with great effect in the domestic animals, particularly the horse and sheep.

It seems even possible that a disposition originally morbid may be transmitted by generation, and acquire a permanent character. The peculiar whiteness of the skin, with red colour of the eye, occurring in the rabbit and ferret, and various other animals, as well as in the Albino of the human race, appears in the first instance to be a morbid affection of the body; and when it occurs in one or two instances only, in the human subject, has the appearance of a leprous cachexy. But, in the animals just mentioned, all the unnatural characters have been lost, and it is established as a permanent variety. We have, moreover, many facts, shewing that, in some cases, casual mutilations are transmitted to the offspring: as want of tail in a cat or dog. (Philosophical Magazine, vol. iv. p. 2. Anderson's Recreations, vol. i. p. 69.) The Jews are frequently born with so little foreskin, that it is hardly possible to circumcise them: this they call being born circumcised. (Philosophical Magazine, vol. iv. p. 5.)

In applying the reasonings derived from

the causes just mentioned, it may not be amiss to advert to the following rules:— 1. The greater the number of causes of degeneration, and the longer they continue to act on the same species, the more obviously will that species deviate from its original formation. Man therefore must be expected to vary more than any animal, since he has been subjected from his very origin to the united agencies of climate, food, and way of life. 2. A cause, possessing in itself sufficient efficacy, may be weakened by the concurrence of other conditions, tending to diminish its operations. Thus, countries placed under the same parallel of latitude have very different temperatures; and the effects of situation on the human subject are varied according as it is more or less elevated, or as it may be influenced by the neighbourhood of the sea, marshes, mountains, or woods, &c. 3. The source of degeneration is often to be sought for, not in any immediate cause, but in the mediate influence of some more latent agency. Thus, the dark colour of the skin may not arise from the direct action of the sun, but from its more remote, but very signal, influence on the hepatic system. 4. These indirect and mediate causes may be so very obscure, that we cannot form even any probable conjecture as to their nature; yet we seem to be warranted in referring those phenomena of degeneration, which hitherto appear enigmatical, to the operation of such unknown powers. Thus we must explain the constant national forms of crania, colours of the eyes, &c.

VARIETIES OF THE HUMAN RACE.

The *colour of the skin* forms a very constant hereditary character, most clearly influenced by that of both parents in the hybrid offspring of different varieties, having a close and nearly uniform relation to that of the hair and iris, and indeed to the whole temperament of the individual; and for all these reasons attracting most immediately the attention of the cursory observer.

The seat of this colour is in a thin mucous stratum, interposed between the cuticle, or dead surface of the body, and the true skin, and called rete mucosum, or rete Malpighii. The native reddish white of the real skin appears through this, which is very thin and almost colourless, in the white races of mankind. But in the darker varieties the rete mucosum is much thicker, and contains throughout its substance a black pigment; while the cuticle and cutis deviate but little from the colour which they have in fair persons.

The different varieties of mankind exhibit every possible shade, between the snowy whiteness of the European female and the jet black of the Negro. Although none of these gradations obtain so universally, as to be found in all the individuals of any particular nation, nor are so peculiar to one race, as not to occur occasionally in other widely different ones, the national varieties of colour may be referred on the whole with sufficient accuracy to the five following principal classes.

1. White, to which redness of the cheeks is almost wholly confined, being observed at least very rarely, if at all, in the other varieties. This obtains in most of the European nations, in the western Asiatics, as the Turks, Georgians, Circassians, Mingrelians, Armenians, Persians, &c. and in the inhabitants of the northern part of Africa.

2. Yellow, or olive (a middle tint between that of wheat and the boiled quince, or dried lemon peel), which characterises the Mongolian tribes, usually called, together with the inhabitants of great part of Asia, Tartars.

3. Red, or copper colour (*bronzé*, Fr. an obscure orange, or rusty iron colour, not unlike the bark of the cinnamon tree) almost confined to the Americans.

4. Tawny, or brown, (*basané*, Fr. a middle tint between that of fresh mahogany and cloves or chesnuts) which belongs to the Malays, and the inhabitants of the South Sea islands.

5. Black, in various shades from the sooty colour, or tawny-black, to that of pitch, or jet-black. This is well known to prevail very extensively in the continent of Africa: it is found also in other very different and distant varieties of the human race, mingled with the national colour, as in the natives of Brazil, California, India, and some South Sea islands, as New Holland and New Guinea. In describing these five varieties, we fix on the most strongly marked tints, between which there is every conceivable intermediate shade of colour. The opposite extremes run into each other by the nicest and most delicate gradations, in every other particular in which the human species differs. This forms no slight objection to the hypothesis of different species. For, on that supposition, we cannot define the number of species, nor can we point out the boundaries which divide them; whereas in animals, which most resemble each other,

the different species are preserved pure and unmixed. Neither does the colour, which we describe in general terms as belonging to any particular race, prevail so universally in all the individuals of that race as to constitute an invariable character, as we should expect if it arose from such an uniform cause as an original specific difference: its varieties, on the contrary, point out the action of accidental circumstances. Thus, although the red colour is very general on the American continent, travellers have observed fair tribes in several parts; as Bouguer in Peru, Cook at Nootka Sound, and Weld near the United States. The natives of New Zealand vary from a deepish black to an olive, or yellowish tinge; in the Friendly Islands they are of a complexion deeper than the copper brown; but several of both sexes are of the olive colour, and some of the women are much fairer.

Climate has generally been regarded as the cause of national colour, and much has been ascribed to the light and heat of the sun. According to the supporters of this opinion, every parallel of latitude is marked with a characteristic complexion. Under the equator we observe the black colour; under the tropics, the dark brown and copper colours; and, from the tropic of Cancer northwards, we discern the olive, changing through every intermediate shade to the fair and sanguine complexion. It is further observed, that an European, exposed to the sun and air, will become brown in summer, and lose this colour again during the winter's cold; that the Asiatic and African women, confined to the walls of their seraglios, are as white as Europeans, while the colour of those exposed to the rays of the sun is dark, like that of the men; that the skin of the Moorish children, which is originally fair and delicate, changes in the boys, who are exposed to the sun, to a swarthy colour, while its fairness is preserved in girls, who keep more within doors: that the South of Spain is distinguished by complexion from the north; and that the inhabitants of the extensive empire of China exhibit every variety of complexion from the fair to the black, according to the latitude of the country which they inhabit. It appears also, that although fair persons have their colour considerably deepened by changing into a hotter climate, yet that the black races are very little affected by coming into cold countries. We must remember too, if Europeans seem to be less affected than we should have supposed by changing to a hot climate, that by avoiding th heat of the sun, by different clothing, diet, &c. they may avoid many of the causes which act with full energy on the natives of such climates. The proximate cause of the dark colour of the skin consists, according to Blumenbach, (de Gen. Human. Var. Nat.) in the secretion of a greater quantity of carbon, and its fixation, by an union with oxygen in the rete mucosum. He states, that Negroes are not born black, but acquire that colour by the access of the atmosphere. He also insists much on the influence which heat exerts on the hepatic functions; and the sympathy existing between the liver and skin, manifested by the dark tinge of the latter in persons of an atrabilarious temperament. There is no climate so favourable for the operation of these causes as that of Africa, which surpasses all others in the continued intensity of its heat, in peculiar properties of the atmosphere, arising from very singular winds, &c. Accordingly its inhabitants having, by exposure to these agencies for a long series of ages, acquired a strongly-marked and deeply-rooted character, transmit it unimpaired, even in foreign climates, to their descendants.

There are varieties of colour in animals, which, whether they owe their origin to climate or to other causes, are as remarkable as those of the different races of mankind, although they occur in the same species. The swine are all white in the northern provinces of France; in Dauphiny, and some other parts, they are black, as also in Spain, Italy, India, China, and America; and in Bavaria, reddish brown. The breeds of cattle manifest similar variations. We have already noticed the changes of colour in animals in cold climates, in speaking of the influence of climate.

Some objections have been made to the explanation of colour derived from climate, which seem to admit of solution. The temperature of any country cannot be determined by considering merely its geographical climate, or its distance from the equator: we must advert at the same time to the physical climate, or that which is produced in any given latitude by such adventitious circumstances as low or elevated position, neighbourhood of water, &c. &c. The Abyssinians, although nearly under the equator, by no means approach in colour to Negroes; for their country is very elevated, the barometer standing, according to Bruce, at twenty-two inches. The inhabitants of

the South Sea islands under the line, and indeed of the South Sea islands in general, are much lighter coloured than we should have expected; and this arises from the coolness natural to insular situations. We find no Negroes under the line in America, as in Africa; a circumstance which admits of an easy solution. On the western side of America there is one of the most elevated regions of the globe. The plain of Quito, which is the base of the Andes, is higher than the top of the Pyrenees, and the summits of these mountains, although in the centre of the torrid zone, are covered with everlasting snow. The country abounds with large rivers, traversing it from west to east. It is covered by a vast quantity of stagnant water, and the largest forests in the globe; it contains no sandy wastes, like those of Africa. Hence the temperature of any place in America is very different from that of corresponding parts of the old continent. At Quito, which is nearly under the line, Reaumur's thermometer never ascends beyond 28°; while at Senegal, in 16° of north latitude, it mounts to 38°. The latitude of Paris corresponds to that of Quebec, and that of London to the almost uninhabitable regions of Labrador.

The brown and tawny colours are not wholly confined to warm climates, they are found in the northern regions of Europe and Asia, countries which, from their excessive cold and consequent sterility, are scarcely habitable. The inhabitants of these regions live on the flesh of the rein-deer and dried fish; their bread is made of pounded fishbones with the bark of the pine or birch-tree. They drink much whale oil. They live under ground, or in huts sunk below the surface of the earth; and during their long nights keep up lamplight, and are enveloped in smoke. At other times they are exposed to the action of a most inhospitable climate, in following their occupations of hunting and fishing. This mode of life will naturally render the skin coarse and dark; and the discoloration thus produced is increased in many instances by the habit of painting the body and smearing it with grease and other substances, which very commonly prevails among savage nations. Such an effect is produced sometimes by these practices that the colour of the skin cannot be ascertained. (Hawkesworth's Collection of Voyages, &c. vol. iv. p. 24, 120, 138.)

We have to observe further, that the effect of climate is much modified by clothing, by the state of society, and the manner of life in general. Dr. Smith (Essay on Complexion and Figure,) informs us that in America, the field slaves, who are badly fed, clothed, and lodged, are remote from the society and example of their superiors, and retain many of the customs and manners of their African ancestors, are slow in changing the aspect and figure of Africa; while the domestic servants, who are employed in the families of their masters, see their manners, and adopt their habits, have advanced far before them in acquiring the agreeable and regular features, and the expressive countenance of civilized society. He also mentions that persons who have been captured from the States, and have grown up in the habits of savage life, contract such a strong resemblance of the natives in their countenance, and even their complexion, as to afford a striking proof that the differences which exist in the same latitude, between the Anglo-American and the Indian, depend principally on the state of society.

Perhaps the strongest circumstance in illustration of the effect of climate on the human complexion, may be derived from the Creoles, which word, sometimes strangely confounded with that of Mulatto, is applied properly to the offspring of European parents born in the East or West Indies. These have such a peculiar character of complexion and countenance, ("austrum quasi spirans vultus et color, maxime quoque comæ et ardentium quasi oculorum,") that they are easily distinguished by those points alone from their relations born in Europe. (Hawkesworth's Collection, vol. iii. p. 374.) The same observation holds good also of the offspring of Persian or Mongolian parents born in the East Indies. (Hodges's Travels in India, p. 3.)

COLOUR AND DENOMINATIONS OF THE MIXED BREEDS.

We have already noticed how constantly the children, produced from the copulation of individuals of different races, exhibit what we may call the middle tinge, formed as it were by the mixture of those of the two parents.

In the first generation the offspring of Europeans and Negroes are called Mulattos; of Europeans and Indians, Mestizes; of Europeans and Americans, Mestizes, also Mestindi, Metifi, and Mamelucks; of Negroes and Americans, Zambi, or Mulattoes, or Lobos, Curibocas, and Kabuglos. All these have the middle countenance and

colour, formed by the union of those of both parents; the latter is more or less brown or tawny, with hardly any visible redness of the cheek. The hair of the Mulatto is curled, in the other instances straight, and almost invariably black; the iris is brown.

In the second generation, two Mulattos produce Casquos; an European and Mulatto a Terceron, who is called by some a Morisco, or Mestize. The hair and countenance of these resemble those of the European; the skin has a slight brown tinf, and the cheeks a degree of redness; the scrotum is blackish in the male, and the labia pudendi rather purple in the female. A Negro and Mulatto produce Griffos, Zambos de Mulata, or Cabros; an European and Indian Mestize, Castissos; an European and American Mestize, Quarterons; an American and a Mestize, Tresalvos; an American and Mulatto, Mestizes; an European and Zambo, Mulattos; two Zambos, Cholos.

In the third generation, Europeans and Tercerons produce Quarterons, Ochavons, Octavons, or Alvinos; which, according to the most acute observers, retain no traces of their African original. A Mulatto and Terceron produce a Saltatra; an European and Castisso, a Postisso; an European and American Quarteron, an Octavon. Some carry the genealogy of these hybrid races into the fourth generation, calling the children of Europeans and Quarterons, Quinterons; but it is not credible that any trace of mixed origin can remain in this case, according to the observation of the most respectable eye-witnesses concerning the third generation. Besides the varieties of colour already noticed, there is a deviation sometimes occurring in the Negro, consisting of white portions of skin of various sizes and numbers, scattered over the body; these are called piebald Negroes, and are produced from two black parents. The appearance is probably owing to some altered action of the skin, and seems analogous to the blackening of portions of the surface, which has been observed in Europeans, particularly in pregnant females.

The skin differs also in some other properties besides its colour. Travellers have described it as remarkably soft and smooth, and as it were silky, in the Carib, Negro, Otaheitean, and Turk. It secretes a matter of peculiar odour in some races, as the Carib, Negro, &c.

The *hair*, as it grows and is nourished from the common integuments, is connected with them in many points by a close kind of sympathy. Hence the spotted Africans have different coloured hairs.—Every gradation of colour, from the fair to the black, is accompanied by its correspondent alterations in the hair. This is true, not only of nations, but also of individuals. A light complexion is accompanied with red or fair hair, a dark one with black hair, almost invariably, even in individuals of the same family; a difference which, according to the philosophy of some writers, would bo a sufficient ground for classing them in different species. The other properties of the hair vary as well as its colour; and these changes may be brought under the four following varieties:

1. Brownish, or red, deviating into yellow and black; this is copious, soft, and long, and slightly undulated: it obtains in most of the temperate climates of Europe; and was formerly particularly noticed in the Germans.

2. Black, strong, straight, and thin; occurring in the Mongolian and American races.

3. Black, softer, dense, and copious, and curled; observable in most of the South Sea islanders.

4. Black and crisp, so as generally to be called woolly; common to all the Ethiopians.

The above division, although sufficient for general purposes, is not uniformly true. For the woolly hair is not confined entirely to the Ethiopian, nor is a black colour invariably found in all the three last varieties. Some tribes of Africans have long hair, and other red coloured people, as those of the Duke of York's Island, have it woolly. The New Hollanders form so complete a medium between the woolly haired African, and the copious curling hair of the other South Sea islanders, that we are completely puzzled how to class them.

Many instances are recorded of red hair in individuals, of such varieties as commonly have it black, as in some South Sea islands.

Some facts seem to indicate that climate and mode of life have considerable influence on the hair. Dr. Smith observes that the hair of Europeans, settled in America, changes visibly towards that of the American Aborigines; so that in the second and third race, straight lank hair is almost universal. In Angora, a small district of Asia Minor, the sheep, goats, cats, and rabbits, have always been celebrated for the uncommon length and fineness of their

hair. The common sheep in warm climates is covered with hair instead of wool. That the mode of life will influence the hair is very certain; the wild pig has a soft curling hair interposed between its bristles, which in the domesticated animal is entirely lost. The influence of various causes, which may be comprehended under the general term of cultivation, is very striking in the sheep and goat; the great difference in the wool produced from the former, under various circumstances, is well known; and a person, who was acquainted with the covering of the goat in European climates, would hardly believe it possible that the material from which the precious shawls of Cashmere are manufactured, could be produced from the same animal.

Colour of the iris. It has long been observed that the colour of the eyes depends on that of the skin; and that these organs are blue or light in fair, and dark in black persons. Hence, newly born children, in these climates, have generally bluish eyes and light hair: and the colour of both changes together at a subsequent period in the individuals who are of a dark complexion. And in the same way, when the hair loses its colour in old age, the pigment of the eye becomes lighter. This connection is still more strongly evinced in spotted animals; and is particularly clear in the rabbit. The native and wild grey kind has a brown iris: the black and white variety has it spotted: and the perfectly white has it red, from the entire absence of colouring matter.

There are three principal varieties of colour in the iris: first, blue; secondly, grey; thirdly, brown, tending to black. These may all occur in different individuals of the same race; and again, they are sometimes confined to the different tribes of the same country, within the boundaries of a few degrees. Thus Linnæus describes, in Sweden, the Gothlander with white hair and greyish blue eyes; the Finlander, with red hair and brown iris; and the Laplander, with black hair and iris. The ancient Germans were distinguished by their blue eyes, as well as red or rather yellow hair (cærulei oculi, rutilæ comæ, Tacitus). The iris of the Negro is the most intensely black, so that in living individuals it can be distinguished from the pupil only by very close inspection.

The Albino. We shall introduce in this place our observations on that singular variety of the human race termed the Albino. We have already stated that the white rabbit and ferret, characterised by the snowy colour of their hair and redness of the eye, seem to have originated from a morbid disposition transmitted by the way of generation, divested in course of time of all character of disease, and established into a permanent variety. The same affection occurs in the human race, but in few and scattered instances, and the persons thus distinguished are named albinos. There are two peculiar circumstances in these individuals. The skin has an unnatural whiteness, often seeming to approach to a slight degree of lepra; and the hair of all parts of the body has the same character. The latter has not the snowy whiteness of old age, nor the elegant light yellow or flaxen appearance of the fair-haired in our climates, but is rather to be compared to the appearance of cream: neither is the colour of the skin like that of the European, but approaching to that of milk, or of a white horse. The eye is deprived of its colouring matter; and hence the iris is of a pale rose colour, and the pupil intensely red, in consequence of the blood contained in the numerous vessels, which almost entirely make up the substance of those parts. Thus, there is a general deficiency of colouring matter; as well as of that of the skin and hair, as of the eye. These affections of the skin and eye are always concomitant. There is generally also a weakness of the latter organ, in consequence of which a strong light cannot be borne. Hence they are described in Java and the isthmus of Darien as going about chiefly by night, when they see best. This peculiarity always exists from the time of birth; it never changes afterwards, and it is sometimes hereditary.

It was observed first in the African, as the great difference of colour would render the variation more striking; and hence the individuals were termed Leucæthiopes, or White Negroes. From their avoiding the light the Dutch gave them the contemptuous name of Kackerlacken (insects shunning the light): the Spaniards called them Albinos, and the French Blafards. So far, however, is this variety from being peculiar to the Negro, or even to the torrid zone, that there is no race of men, nor any part of the globe, in which it may not occur. Blumenbach has observed sixteen instances in Germany; and refers to various authors who have seen it in most parts of the world (De Gen. Hum. Variet. sect. 3, §. 78). It happens in many of the class mammalia and birds.

National features. Although it is a com-

mon and very just observation, that two individuals are hardly to be met with possessing exactly the same features, yet there is generally a certain cast of countenance common to the particular races of men, and often to the inhabitants of particular countries. The national varieties of countenance may be reduced to the five following:

1. An oval and straight face, with the different parts moderately distinguished from each other; forehead rather flattened; nose narrow, and slightly aquiline; no prominence of the cheek-bones; small mouth, with lips slightly turned out, particularly the lower one; a full and rounded chin. This is the kind of countenance which accords most with our ideas of beauty. It may be considered as a middle, departing into two extremes, exactly opposed to each other; of which one consists in a lateral expansion of the face; and the other in its being extended downwards. Each of these includes two varieties, which are most readily distinguished by a profile view: one, in which the nose and other parts run together, and the other, in which they are more prominent and separate.

2. Broad and flattened face, with little distinction of parts; broad space between the eyes; flat nose; rounded cheeks, projecting externally; narrow and linear aperture of the eye-lids; slight projection of the chin. This is the face of the Mongolian tribes, commonly, but erroneously, called the Tartar face.

3. Broad face and prominent cheek-bones, with the parts projecting more in a profile view; short forehead; the eyes more deeply seated; the nose rather flattened, but prominent. Such is the countenance of most of the Americans.

4. Narrow face, projecting towards its lower part; arched forehead; projecting eyes; a thick nose, confused on either side with the cheeks; the lips, particularly the upper one, very thick; the jaws prominent; and the chin retracted. This is the Negro countenance.

5. The face not so narrow as in the preceding; rather projecting downwards, with the different parts more distinct; the nose rather full and broad, particularly towards its end; the mouth large. This belongs to the Malay race, and particularly to the inhabitants of the South Sea islands.

Here, as on the subject of colour, the different characters run into each other by the most gentle gradations; so that although any two extremes, when contrasted, appear strikingly different, they are connected by numerous intermediate, and very slightly differing shades. And no formation is exhibited so constantly in all the individuals of one race, as not to admit of numerous exceptions. Blumenbach states, that of the numerous African individuals whom he has attentively observed, of the portraits and profiles of others, and of the various Negro crania which have come under his inspection, no two were exactly alike; but several differences appeared, constituting an insensible gradation towards the other varieties, even in their most agreeable modifications. Vaillant says of the Caffre women, that setting aside the prejudice which operates against their colour, many might be accounted handsome even in an European country; Le Maire makes the same observation concerning the Negresses of Senegal and Gambia; and the accurate Adanson confirms it of the Senegambians, which possess, according to him, beautiful eyes, small mouth and lips, and well proportioned features; many, he says, are perfect beauties. The testimony of Mungo Park is to the same effect concerning the Jaloffs, which have not the protuberant lip, nor flat nose, of the African countenance. The features of the Friendly Islanders vary much according to Cook; he saw many genuine Roman noses, and hundreds of European faces among them.

It is obvious that the causes of national variety in the features must be much the same with those that influence the form of the head, as much must depend on the bones both of the cranium and face. It is difficult, and perhaps impossible, to assign any very satisfactory ones. Climate has been considered a leading circumstance; but we cannot readily understand how that can operate; and some facts militate particularly against its efficacy, as the peculiar characters of the Jew and Gipsy countenance preserved, after such long residence in very different climates from that of their original abode; on the contrary, the common origin of the Laplander and Hungarian, who differ widely in features, seems to countenance the opinion.

Form of the cranium. It is sufficiently obvious that there must be a close connexion between the external parts of the face, or the features, and the bony compages which lies under and supports these; so that we might venture to affirm that a blind man, if he knew the vast difference which exists between the face of a Calmuck and that of

a Negro, would be able to distinguish the crania of these two races of mankind by the mere touch. Nor could you persuade any person, however ignorant of the subject, that either of these skulls belonged to a head, similar to those from which the divine examples of ancient Grecian sculpture were copied. Thus much is clear and undeniable, as to the general habit and appearance of the skull. A more careful anatomical investigation of genuine specimens of the crania of different nations, will throw still further light on the subject of the varieties of the human race. Such a comparison will shew us that the form of the cranium differs no less than the colour of the skin, or other characters, in different individuals; and that one kind of structure runs by gentle and almost inobservable gradations into another; yet that there is on the whole an undeniable, nay, a very remarkable constancy of character, in the crania of different nations, contributing very essentially to national peculiarities of form, and corresponding exactly to the features, which characterise such nations. Hence, anatomists have attempted to lay down some scale of dimensions, to which the various forms of the skull might be referred; and by means of which they might be reduced into certain classes. Of these, the facial line of Camper claims the most attention; its application is explained in the article on Comparative Anatomy. Considered in a general view, this is objectionable, as it only indicates the differences in the projection of the jaws. Blumenbach states that the most important points, those especially which contribute to the comparison of national characteristics, can be most completely observed by placing the different crania, with the zygomas in the same perpendicular line, on a table in a row, and contemplating them from behind. This method he calls the norma verticalis: and illustrates by means of three heads. The middle of the three, distinguished by the beauty and symmetry of all its parts, is that of a Georgian female; the two outer ones are examples of heads differing from this in the opposite extremes. That which is elongated in front is the head of a Negress, from the coast of Guinea: the other, which is expanded laterally, and flattened in front, is the cranium of a Tungoose, from the north-east of Asia. The margin of the orbits and the zygoma are elegantly contracted in the Georgian; and the jaws are hidden by the symmetrical expansion of the forehead. In the Ethiopian the maxillary bones, and indeed the whole face, are compressed laterally, and project in front. In the Tungoose, on the contrary, the ossa malæ, ossa nasi, and glabella, are situated on the same horizontal level, and are enormously expanded on either side. (Two plates illustrating the national formations of the skull are given in Rees's New Cyclopedia, in which the subject itself has been considered at greater length under the article Cranium, by Mr. Lawrence).

The national forms of the cranium may be referred to five chief divisions. The first presents a somewhat globular form; with the forehead moderately expanded; the cheek-bones narrow, and not prominent, but descending in a straight line from the external angular process of the os frontis. The alveolar margin of the jaws is rounded; and the front teeth of both jaws are placed perpendicularly. This form is observable in most Europeans. The cranium of the Turk is particularly globular in its form. This shape, which they consider as elegant, and adapted to their turbans, is said, on very good authority, to be produced by artificial pressure after birth.

In the second variety, including the Mongolian tribes, the head is of a square form, and the cheek-bones stand out widely on either side. The glabella, and ossa nasi, which are flat and very small, are placed nearly in the same horizontal line with the ossa malarum. There are scarcely any superciliary ridges; the entrance of the nostrils is narrow; and the malar fossa forms but a slight excavation. The alveolar edge of the jaws is obtusely arched in front; the chin rather prominent.

The third variety contains the Africans. The cranium is narrow, being compressed at the sides, where the temporal fossa is of immense extent. The forehead is narrow, and strongly arched; the cheek-bones project anteriorly; the nostrils are large; the malar fossa considerable and deep; the alveolar edges of both jaws stand very much forwards, they are narrow, elongated, and of an elliptical figure; the front teeth of the upper jaw are oblique in their position; the lower jaw is large and strong; but the chin, instead of projecting as far as the teeth, as it does in the European, recedes considerably, as in the monkey. The substance of the cranium is generally thick, and the skull is consequently heavy. A slight comparison of the Negro with the European skull, will suffice to shew that the

cranium is more capacious in the latter than in the former case. The lateral compression of the Ethiopian head, together with its narrow arched forehead, compared to the almost globular European cranium, with its broad expanded frontal portion, sufficiently account for this difference. At the same time, the bones of the face are proportionably larger in the African; the foramina for the transmission of nerves are more ample; and, according to Soemmerring, the nerves arising from the basis of the brain are more considerable. The result of these observations, together with the unequivocal similarity in external form between the African cranium and that of the monkey, leads us inevitably to the inference that the Negro approximates in structure to those animals. The facts which we possess on this subject confirm the conclusion, which would naturally be drawn from these premises, that the mental faculties of the Negro are inferior to those of the white nations. Let it not, however, be conceived that these remarks are intended to degrade the African to a level with brutes, or to justify those who consider him merely as a species of monkey. He is distinguished from all animals by the same grand and constant characters which belong to every variety of the human race. We merely state the obvious inferences deducible from acknowledged facts; and consider that a difference in mental powers cannot afford any stronger argument in proof of a diversity of species than the numerous distinctions in bodily structure. Indeed, when we find the different races of mankind characterized by such numerous differences of organization, it would be a matter of surprise if no diversity could be discovered in their mental endowments. The description which we have given above of the Negro cranium, must be understood in a general sense, and not as universally and unexceptionably applicable. Travellers inform us that several Africans differ from the European features and physiognomy only in colour; so that the peculiar formation of the cranium, on the faith of which some philosophers would class these people as a distinct species, is by no means a constant character.

The two next varieties are not so strongly characterized as the three which we have already considered. They form indeed two intermediate gradations, between the European and the Mongolian on one side, and the African on the other.

In the fourth, or American variety, the cheeks are broad, but the malar bones are more rounded and arched than in the Mongolian; and not expanded to such an extent on either side, nor possessing such an angular form. The orbits are generally deep. The form of the forehead and vertex is influenced in many instances by the efforts of art. This is most strikingly evinced in the head of the Carib, in which the upper part is sometimes literally flattened to a level with the eye-brows, in a manner which could not be credited, unless upon the most unexceptionable testimony. It appears, from the relation of travellers, that they employ different methods of accomplishing their object; as by tying a plate of wood on the forehead; or by compressing the head between two plates; or by pressure with the hand. The instruments and bandages, by which the pressure is made, are delineated and described by Dr. Amic, of Guadaloupe, in the xxxixth vol. of the Journal de Physique.

In the fifth, or Malay variety, the cranium is moderately narrowed at its upper part; the forehead rather expanded; and the upper jaw slightly prominent.

We cannot at present deliver any very satisfactory account of the causes of those differences which unquestionably prevail in the form of the cranium in the different varieties of the human species; much less are we able to understand the manner in which any assigned cause may be supposed to operate in producing its effect.

It certainly happens in many instances, that the bones of the skull receive a peculiar form, from various artificial causes. Not to mention the flattened occiput of the Germans in the time of Vesalius, there can be no doubt that the form of the forehead in the Carib cranium is owing to artificial pressure. A similar rage for improving the shape of the head has been very prevalent on the continent of America. "The Indians," says Adair, "flatten their heads in divers forms; but it is chiefly the crown of the head they depress, in order to beautify themselves, as their wild fancy terms it; for they call us long-heads by way of contempt." (History of the American Indians, p. 8.) The method by which they accomplish their purpose, is thus described by the same author. "They fix the tender infant on a kind of cradle, where his feet are tilted above a foot higher than the horizontal position; his head bends back into a hole made on purpose to receive it, where he

bears the chief part of his weight on the crown of the head, upon a small bag of sand, without being in the least able to move himself. By this pressure, and their thus flattening the crown of the head, they consequently make their heads thick, and their faces broad." It is a matter of surprise, that any person should have ventured to call in question the truth of a fact, supported by the concurrent testimony of so many eye-witnesses. Many tribes, both of North and South America, are distinguished by names derived from these very practices. "The word *Omaguas*, as applied to a nation of Peru, as well as that of *Cambecas*, in the language of Brasil, signifies flat-head: for these people have the strange custom of pressing the forehead of their newly-born children, between two plates, in order to make them, as they say, resemble the full moon." (Condamine in the Memoirs de l'Acad. des Sciences, 1745, p. 427.) Hence also the "tetes de boule," and the "tetes plates" of Charlevoix.

We have one remark only to add on this part of the subject; *viz.* that the differences in the form of the cranium are by no means sufficient to authorize us in assigning the different races of mankind in which they occur, to species originally different: for they are not more considerable, nor even so remarkable, as some variations which occur in animals confessedly of the same species. Thus the head of the wild boar is widely different from that of the domestic pig. The different breeds of horses and dogs are distinguished by the most striking dissimilarities in the head: in which view the Neapolitan and Hungarian horses may be contrasted. The wild original of the cow possesses large lacrymal fossæ, which are completely lost in the domesticated animal. The very singular form of the head in the Paduan fowl is a more remarkable deviation from the natural structure, than any variation which occurs in the human cranium.

VARIATIONS IN THE FORM AND SIZE OF CERTAIN PARTS OF THE BODY.

The ears are moveable, and stand at some distance from the head in many savages; where they have not been confined by dress.

The lobulus is increased and elongated considerably by artificial means in some of the South Sea islanders, and in other instances.

Many travellers have remarked, that the breasts are long and pendulous in several savage tribes, particularly in Africa and the South Sea islands; but some of the accounts are undoubtedly exaggerated, and the circumstance does not in any case seem common to a whole tribe or nation. The cause seems to consist in long-continued suckling, and in the habit of suckling the children at the back of the mother. In some cases artificial means of elongating these parts are employed, from peculiar notions of beauty. A large and swoln state of the breast altogether was observed formerly in the Egyptians; and the Portuguese women of modern days are said to be remarkable in the same way.

Negroes are particularly famous for their organs of generation: and specimens preserved in anatomical cabinets seem to justify their celebrity for the size of these parts; but it is doubtful whether this be a general character. The Hottentot women possess large nymphæ, which cover the opening of the vagina, and have given rise to some absurd reports of travellers.

The legs of the Hindoos are said to be particularly long, and those of the Monguls short: it has also been stated, that the constant practice of riding renders them crooked in the Calmucks. In the Negro they are curved, so as to render the individual knock-kneed; and the calf is remarkably high: they are also distinguished by the broad and flat form of the foot.

Although we cannot assign any satisfactory reasons for all these varieties, there is none which does not exist in a still greater degree in animals of the same species. What differences in the figure and proportion of parts do we observe in the various breeds of horses; in the Arabian, the Barb, and the German! How striking the contrast between the long-legged cattle of the Cape, and the short-legged of England. The same differences in the legs are seen in swine. The cows have no horns in some parts of England and Ireland; in Sicily, on the contrary, they are very large. We should also mention here a breed of sheep with an extraordinary number of horns, as three, four, or five, occurring in northern countries, and accounted a mere variety, (*ovis polycerata*); the Cretan breed of the same animal with long, large, and twisted horns; the Solidungular swine, with undivided hoof, as well as others with three divisions of that part; the five-toed fowl (*Gallus pentadactylus*); the broad-tailed sheep of Tartary, Thibet, &c. in which the

tail grows so large that it is placed on a board, supported by wheels, for the convenience of the animal; and the rumpless fowl of America, and particularly Virginia (*Gallus Ecaudatus*), which has undoubtedly descended from the English breed.

Stature. No part of our subject has been more disgraced by fables and hyperbolical exaggeration, than the present division. Not to mention the pigmies and giants of antiquity; the bones of different large animals, ascribed to human subjects of immoderate stature, even by such men as Buffon, sufficiently prove our assertion. The accuracy of modern investigation has, however, so completely exposed the extravagance of such suppositions, that we are relieved from the necessity of a detailed consideration. All the remains of antiquity, which afford us any inferences on the subject of stature, such as mummies, human bones, and particularly teeth taken from the oldest burial places and urns, armour, &c. concur in proving, that the ancients did not exceed the moderns in this respect. Yet amongst the latter there are obvious national differences. Of European nations some parts of Sweden and Switzerland are distinguished for tallness, as Lapland is in the contrary respect. The Abipons in the new world are of large size, and the Esquimaux small; but neither are very remarkable: and there is no such difference between any two modern nations, but what admits of easy explanation from the common causes of degeneration, and the analogous phenomena furnished by the natural history of other animals.

The Patagonians, or Tehuels, which occupy the south-east part of the extremity of South America, seem to be the tallest of the human race; but their height has been much exaggerated. Pigafetta, who accompanied Magalhaens on his voyage round the world, asserted that they were twice as tall as Europeans, and the accounts of subsequent navigators have been very contradictory. They seem, in truth, to be a tall, though not gigantic race, and to possess a muscular frame. According to Wallis, Bougainville, and Carteret, the ordinary height may be six feet; and none seem to exceed six feet seven inches: a stature not so very remarkable, since other native tribes of the same continent have been remarked for their height. As they are a wandering race, we cannot be surprised at finding that Europeans visiting the coast have not always been able to see them. The accounts of travellers prove, that the height of the Patagonians is not a peculiar circumstance. Bartram represents the Muscogulges and Cherokees of North America, inhabiting between 31° and 35° of North latitude, as taller than Europeans; many being above six feet, and few under five feet eight or ten inches. (Travels, p. 482), The Caffrees, according to Barrow, are "tall, robust, and muscular, and distinguished by a peculiar firmness of carriage; some of them were six feet ten inches, and so elegantly proportioned that they would not have disgraced the pedestal of the Farnese Hercules. The accounts of a pigmy race, called Quimos or Kimos, in the interior of Madagascar, do not seem to be at all authentic. The Laplanders and Nova Zemblians, in Europe, the Samoieds, Ostiacs, Yakuts, and Tungooses in Asia, and the Greenlanders and Esquimaux of America, all, in short, who inhabit high northern latitudes, are short in stature, measuring from four to five feet; and they agree remarkably in other characters, although occupying such distant countries. This accordance must be explained by exposure to the same causes; living in a barren and inhospitable climate, and exposed equally to its rigour, feeling the same wants, and having the same means of gratifying them, should we not expect a similarity of stature, colour, countenance, &c.? It seems rather doubtful, whether the miserable Pescherais, who wander naked over the rocks of Terra del Fuego, are also diminutive; but Barrow informs us, that the Boshmen, who adjoin the Cape, scarcely ever exceed four feet nine inches.

Every one will immediately perceive, that the differences of stature in the human race are not equal to those occurring in different breeds of animals. The pigs taken from Europe into the island of Cuba have grown to twice their original size; and the cattle in Paraguay have experienced a great increase in this respect.

That climate possesses an influence, seems to be proved from the circumstance of the Laplanders and Hungarians, which differ so widely in stature and formation, having descended from a common source.

Physiological considerations render it probable, that food will be efficacious in increasing or diminishing stature. The Arees or nobles of Otaheite and the Society Islands exceed the other natives in stature and personal beauty; and this is ascribed by Forster to their enjoying a more copious

and luxurious food. The use of ardent spirits is said to have diminished the size of the native Americans in some instances.

That the state of society and manner of life have great influence on the stature, may be proved by comparing the present Germans with their ancestors, as described by the Roman authors. The ancient Germans lived chiefly on animal food, as milk and flesh: they were strangers to the use of wine and spirituous liquors; in time of peace they were employed in the chase, free from those cares which so often agitate and oppress more civilized people. They refrained from the enjoyment of women till a late period; "Sera juvenum Venus eoque in exhausta pubertas." Hence they appear to have been of immense size and strength, and undaunted courage; "immanes animis et corporibus" is the forcible language of Pomponius Mela. Conring, after comparing all the accounts of the writers of those times, states their stature at six feet three inches; which equals that of the Patagonians, and certainly exceeds that of the modern Germans.

As the ancient Germans seem to have exceeded the stature of the moderns, so, if we may credit their philosophic describer, the cattle were distinguished in the contrary way, which is not we believe the case at present. "Pecorum fecunda, sed plerumque improcera. Ne armentis quidem suus honor, aut gloria frontis." TACITUS.

The observations of Barrow concerning the Caffres, whose superior stature we have just noticed, confirm our reasonings as to the effect of climate and manner of life. "The natives of Caffraria," says he, "if taken collectively, are perhaps superior in point of figure to the inhabitants of any other country on earth: they are indeed exempt from many of those causes, which in civilized society tend to debilitate and impede the growth of the human body. Their diet is perfectly simple, their exercise conducive to health, and the air which they breathe is salubrious. Strangers to the licentious appetites which frequently proceed from a depraved imagination, they cheerfully receive the bounteous gifts of nature, and when midnight sways her ebon sceptre over the country,

"Sweetly composed the weary peasant lies,
Tho' through the woods terrific winds resound;
Tho' rattling thunder shakes the vaulted skies,
Or vivid lightning runs along the ground."

We must remember that the stature of any tribe or nation will be gradually changed by inter-marriages with others, and that it can be preserved pure only by avoiding such intercourse. That hereditary disposition has great influence on the size of the body, is undeniably proved by numerous examples of families remarkable for their tallness or lowness of stature.

Faculties of the Mind. The different progress of various nations in general civilization, and in the culture of the arts and sciences, the different characters and degrees of excellence in their literary productions, their varied forms of government, and many other considerations, must convince us, beyond the possibility of doubt, that the races of mankind are no less characterized by diversity of mental endowments, than by those differences of organization, which we have already enumerated and considered. Such however has been the effect of education, of laws, of peculiar habits and customs, and of the different forms of government, in modifying the mind and character of men, that we cannot now discern what should be ascribed to original difference, and what should be referred to the operation of these external causes. That climate will exert a powerful influence on the mind may be very reasonably expected; and it has an analogous influence on the animal creation. We are informed that the dog in Kamtschatka, instead of being faithful and attached to his master, is malignant, treacherous, and full of deceit. He does not bark in the hot parts of Africa nor in Greenland; and in the latter country loses his docility, so as not to be fit for hunting.

Yet we are decidedly of opinion that the differences of intellect are not sufficient in any instance to warrant us in referring a particular race to an originally different species; and we particularly protest against the sentiments of those, who would either entirely deny to the Africans the enjoyment of reason; or who ascribe to them such vicious, malignant, and treacherous propensities as would degrade them, even below the level of the brute. It can be proved most clearly, and the preceding observations will suffice for this purpose, that there is no circumstance of bodily structure so peculiar to the Negro, as not to be found also in other far distant nations; no character, which does not run into those of other races, by the same insensible gradations, as those which connect together all the varieties of mankind. We cannot but

admire the reasoning and humanity of those, who, after tearing the African from his native soil, carrying him to the West Indies, and dooming him there to perpetual labour, complain that his understanding shews no signs of improvement, and that his temper and disposition are incorrigibly perverse, faithless, and treacherous. Let us however observe him in a somewhat more favourable state than in those dreadful receptacles of human misery, the crowded decks of the slave-ship, or in the less openly shocking, but constrained and extorted, and therefore painful, labours of the sugar plantation. The acute and accurate Barbot, in his large work on Africa, says, "The blacks have sufficient sense and understanding, their conceptions are quick and accurate, and their memory possesses extraordinary strength. For, although they can neither read nor write, they never fall into confusion or error in the greatest hurry of business and traffic. Their experience of the knavery of Europeans has put them completely on their guard in transactions of exchange: they carefully examined all our goods, piece by piece, to ascertain if their quality and measure are correctly stated; and shew as much sagacity and clearness in all these transactions, as any European tradesman could do." Of these imitative arts, in which perfection can be attained only in an improved state of society, it is natural to suppose that the Negroes can have but little knowledge; but the fabric and colours of the Guinea cloths are proofs of their native ingenuity; and, that they are capable of learning all kinds of the more delicate manual labours, is proved by the fact, that nine-tenths of the artificers in the West Indies are Negroes: many are expert carpenters, and some watch-makers. The travels of Barrow, Le Vaillant, and Mungo Park, abound with anecdotes honourable to the moral character of the Africans, and proving that they betray no deficiency in the amiable qualities of the heart. The former gives us a most interesting portrait of the chief of a tribe: "His countenance was strongly marked with the habit of reflection; vigorous in his mental, and amiable in his personal qualities, Gaika was at once the friend and ruler of a happy people, who universally pronounced his name with transport, and blessed his abode as the seat of felicity." Alas! many European kings would appear to very little advantage by the side of this savage. The drawings and busts executed by the wild Boshmen in the neighbourhood of the Cape are praised by the same traveller for their accuracy of outline, and correctness of proportion.

Instances are by no means wanting of Negroes who have distinguished themselves in literature and the arts, when favoured by fortune with opportunities of education and improvement. Freidig in Vienna was a capital performer on the violin, and an excellent draftsman. Hannibal, a colonel of artillery in the Russian service, was very well informed in the mathematical and physical sciences; as also was Lislet of the isle of France, who was made on that account a corresponding member of the French academy. Fuller of Maryland was an extraordinary example of arithmetical knowledge: being asked in company how many seconds a man had lived, who was seventy years, and some odd months old, he gave the number in a minute and a half: on reckoning it, a different result was obtained; "you have forgotten the leap years," says the Negro: the necessary addition brought it right. A. W. Amo took the degree of doctor in philosophy at Wittenberg in 1734, and produced two ingenious and well-written dissertations: and Vasa and Ignatius Sancho have distinguished themselves as literary characters in this country. Blumenbach, after mentioning these instances in his Beyträge zur Naturgeschichte, sarcastically observes, that entire and large provinces of Europe might be named, which had not furnished such good writers, poets, philosophers and correspondents of the French academy; and he adds that no savage people have given such strong indications of a capability of improvement, and even of scientific cultivation, as the Negroes; and consequently that none can approach more nearly to the polished nations of the globe. Let us conclude then with the quaint but humane observations of the preacher, who called the Negro "God's image, like ourselves, although carved in ebony."

We shall conclude the present article with giving the generic character of man; and a general description of the five varieties, into which the human race has been divided by Blumenbach.

Generic character: erect, two-handed; prominent chin. Teeth of uniform height in an unbroken series; the lower incisors perpendicular.

As we have shewn, on the one hand, that there is no circumstance of difference between the varieties of the human race, which does not appear in a still

greater degree among animals chiefly of the domesticated kinds, arising from the ordinary sources of degeneration; so there is no point, whether of colour, countenance, or stature, which does not pass by imperceivable gradations into the opposite character, rendering all these distinctions merely relative, and reducing them to differences in degree. Hence it is obvious, that any division of the varieties of the human race must be in a great measure arbitrary. For the same reason one or two characters are not sufficient for determining the race, but an union of several is required; and even this is exposed to many exceptions in each variety.

1. *Caucasian variety.* White skin, red cheeks, brownish hair, head of a somewhat globular form; oval and straight face, with features moderately separate from each other, expanded forehead, narrow and rather aquiline nose, and small mouth: front teeth of both jaws perpendicular; lips gently turned out, and chin full and rounded.

It includes the Europeans (excepting the Laplanders, and rest of the Finnish race); the Western Asiatics, as far as the river Ob, the Caspian sea, and the Ganges; and the northern Africans.

The name of this variety is derived from Mount Caucasus, because in its neighbourhood we meet with the most beautiful race of men in the world, viz. the Georgians. From the accounts of numerous travellers, who all agree on this subject, we select the remark of Chardin: "The blood of Georgia is the finest in the East, and I may say in the world. I have not observed a single ugly countenance in that country in either sex; but have seen numerous angelic ones. Nature has bestowed on the women graces and charms, which we see in no other place. It is impossible to look at them without loving them. More beautiful countenances, and finer figures, than those of the Georgian women, cannot even be imagined."

Various reasons conspire in inducing us to place the first families of men in this quarter; and this race forms a medium between the two following varieties. An argument on this subject arises from the white colour of the Caucasian race, which we should be disposed to consider as the primitive colour of men: since the white easily degenerates into the darker shades, while those, when once fixed, hardly change at all.

2. *Mongolian variety.* Olive colour; black, straight, strong, and spare hair; head of a square form; broad and flattened face, with the features running together; the glabella (interval between the eye-brows) flat and very broad; nose small and flat; rounded cheeks projecting externally; narrow and linear aperture of the eyelids; slight projection of the chin.

This includes the rest of the Asiatics, (excepting the Malays); the Finnish races of the colder parts of Europe, as the Laplanders, &c.; and the tribes of Esquimaux, extending over the northern parts of America from Bhering's Strait to the extremity of Greenland.

The Mongolians, widely scattered over the continent of Asia, have generally, but erroneously, been included with some of very different origin and formation, under the name of Tartars; whereas the last-mentioned tribes, properly so called, belong to the first division of the human race. The Calmucks, and other Mongolian nations, which overran the Saracen empire, under Zenghis Khan, about the middle of the thirteenth century, and had entered Europe, are described in the "Historia Major" of Matthew Paris under the name of Tartars, whereas that name (or, as it should be spelled, Tatars) properly belongs to the western Asiatics, who had been vanquished by the Monguls. The error, however, arising from this source, has been propagated down to the present day, so that in the works of the most approved naturalists, as Buffon and Erxleben, we find the characters of the Mongolian race ascribed to what they call the Tartars.

The Tartars indeed are connected by the Kirgises, and neighbouring tribes, to the Monguls, in the same way as the latter are joined by the inhabitants of Thibet to the Indians; by the Esquimaux, to the Americans; and by the Philippine islanders, with the Malays.

3. *Ethiopian variety.* Black skin; black and woolly hair; head narrow, and compressed laterally; arched forehead; cheekbones standing forwards; prominent eyes; thick nose, confused with the extended jaw; alveolar arch narrow, and elongated anteriorly; the upper front teeth projecting obliquely; the lips, and particularly the upper one, thick; the chin receding; knees turned in in many instances. The remaining Africans, besides those classed in the first variety, belong to this.

Several of the observations in the preceding parts of this article shew how ill-founded is the opinion of those who consider the Africans as a distinct species, merely because

his colour, a very striking character, is so unlike our own. The observation, that Negroes resemble monkeys more than those of the other varieties, is true in the same sense as it might be said, that the variety of the pig, which has a solid hoof, resembles the horse more nearly than other pigs; but the comparison itself is not a very important one, since it has been made, even by accurate observers, of several nations in the other varieties; as the Laplanders, Esquimaux, Caaiguas of South America, the inhabitants of the island Mallicollo, &c.

4. *American variety.* Red colour; black, straight, strong, and thin hair; short forehead; deep eyes; nose somewhat flattened, but prominent; a broad, but not flattened face, with the cheeks standing out, and the different features projecting distinctly and separately; the forehead and vertex often deformed by art. This variety includes all the Americans, with the exception of the Esquimaux.

Several idle tales have been propagated concerning the distinguishing characters of this race. Some have denied the existence of a beard in the male, and that of the menstrual discharge in the female; and others have ascribed an uniform colour and countenance to all the inhabitants of this vast continent. The concurring testimonies of all accurate modern travellers prove clearly that the Americans have naturally beards; that it is a very general custom with them, as it has been with several Mongolian and Malay tribes, carefully to eradicate this excrescence; but that various hordes in different parts of the continent preserve it as other men do. From a cloud of unanimous reports on this subject we select the following statement of the immortal Cook, respecting the natives of Nootka Sound. "Some have no beards at all, and others only a thin one on the point of the chin. This does not arise from an original deficiency of hair in those parts, but from their plucking it out by the roots: for those who do not destroy it have not only considerable beards on every part of the chin, but also whiskers, or mustachios, running from the upper lip to the lower jaw obliquely downwards." (Last Voyage, vol. ii. p. 240.) The observation concerning the menses has arisen from the women being secluded during their appearance. The redness of the skin is not so constant, but that it varies in many instances towards a brown, and approaches likewise in some temperate situations to the white colour. Cook states, that the natives about Nootka Sound are little inferior in fairness to Europeans; and Bouguer makes the same observation of the Peruvians on the Andes. It is also fully ascertained at present, that the Americans possess the same varieties of feature which are observed in the other races.

5. *Malay variety.* Brown colour; hair black, soft, curled, and abundant; head moderately narrow, and forehead slightly arched; nose full and broad towards the apex; large mouth; upper jaw rather prominent; the features, when viewed in profile, projecting and distinct. The inhabitants of the peninsula of Malacca, of the South Sea, Ladrone, Philippine, Molucca, and Sunda islands, are arranged under this division.

As the Americans in their national characters hold the middle place between that middle variety of the human race, which we have called the Caucasians, and one of the extremes, viz. the Mongolians; so the Malay forms the connecting link between the Caucasian and the Ethiopian. The name of Malay is given to it, because most of the tribes which it includes, as those which inhabit the Indian islands near Malacca, the Sandwich, Society, and Friendly islands, also those of Madagascar, and thence to Easter island, use the Malay language.

The inhabitants of such various and distant countries may reasonably be expected to differ considerably in elegance of form, and in other circumstances of bodily organization. Hence some have even described two races in the island of Otaheite; one of light colour, tall stature, and countenance scarcely distinguishable from the European: the other of moderate stature, with the colour and countenance of the Mulatto, crisp hair, &c. The latter, therefore, constitutes an intermediate gradation, passing towards the inhabitants of the western islands of the Pacific Ocean. And of these the men of the New Hebrides form a link of connection with those of New Guinea and New Holland, which are so very similar to the Ethiopian variety, that they might be arranged without impropriety under that division.

The varieties which we have just stated are so many proofs of that pliancy so wisely bestowed by nature on the human constitution, to enable it to adapt itself to every clime. Thus the goodness of the Creator appears, in forming the whole world for man, and in opening to him every opportu-

nity of enlarging his habitation, and multiplying his scientific acquirements; instead of confining him, like the inferior animals, to a bounded range. He is completely unrestrained in the choice of his dwelling by considerations of air, temperature, &c.; and consequently far exceeds all other parts of animated creation in extension over the surface of the globe. Gmelin experienced cold of 126° below 0 of Fahrenheit's scale, at Jeniseik, in Siberia. The Greenlander lives, and follows his occupations, where the vegetable creation can no longer subsist, and where the snow-bunting, with the polar fox and bear, half frozen, and perishing with hunger, hide themselves in holes of the ground. On the contrary, in Senegal, the thermometer mounts sometimes to 117° above 0; and a natural warmth of 125° has been experienced. In short, man lives in every part of the known world (excepting some unexplored northern countries, and a few remote southern islands), from Greenland to Terra del Fuego, from Spitzbergen to the Cape, from the 80th degree of north to the 58th of south latitude.

MANDAMUS, is a writ issuing in the King's name, out of the Court of King's Bench, and directed to any person, corporation, or inferior court of judicature, commanding them to do some particular thing, as appertaining to their office and duty.

A writ of mandamus is a high prerogative writ, of a most extensive remedial nature, and may be issued, in some cases, where the injured party has also another more tedious method of redress, as in the case of admission or restitution to an office; but it issues in all cases where the party has a right to have any thing done, and hath no other specific means of compelling its performance. And this general jurisdiction and superintendancy of the King's Bench over all inferior courts to restrain them within their bounds, and to compel them to execute their jurisdiction, whether such jurisdiction arises from a modern charter, subsists by custom, or is created by act of parliament; yet being in *subsidium judicii*, has of late been exercised in a variety of instances.

It is grounded on a suggestion by affidavit of the party's own right, and the denial of justice below. It is sometimes granted upon a rule to shew cause only, but sometimes it is peremptory in the first instance. When it issues to do the thing, or shew cause, an action lies for a false return, if there be in fact such false return; but the Court will not itself try the truth of the return in the first instance. It is usually applied to the restoring of officers in corporations, or to electing new ones where others have been wrongfully elected. See statutes 9 Anne, c. 20, and 12 George III. c. 21. It is a writ of very general application, and great utility, and may be said generally to lie where any person by his office has a clear duty to perform, and neglects to perform it, and the Court can order him to do the act required.

MANDRAKE, a species of the Atropa, from which a reference has been made, possesses a long taper root resembling the parsnep; running three or four feet into the ground; immediately from the crown of the root arises a circle of leaves, at first standing erect, but when grown to their full size, they spread open and lie upon the ground; these leaves are more than a foot in length, and about five inches broad in the middle, of a dark-green colour, and a fœtid scent: among these come out the flowers, each on a scape, three inches in length; they are five-cornered, of an herbaceous white colour, spreading open at top like a primrose, having five hairy stamens, and a globular germ supporting an awl-shaped style, which becomes a globular soft berry, when full-grown as large as a nutmeg, of a yellowish green colour, and when ripe full of pulp.

Many singular facts are related of this plant, among which we select the following: the roots have been supposed to bear a resemblance to the human form, and are figured as such in the old herbals, being distinguished into the male with a long beard, and the female with a prolix head of hair. Mountebanks carry about fictitious images, shaped from roots of bryony and other plants, cut into form, or forced to grow through moulds of earthen ware, as mandrake-roots. It was fabled to grow under a gallows, where the matter falling from the dead body gave it the shape of a man; to utter a great shriek, or terrible groans at the digging up; and it was asserted, that he who would take up a plant of mandrake, should in common prudence tie a dog to it, for that purpose; for if a man should do it himself, he would surely die soon after. See Martyn's botany.

MANDREL, a kind of wooden pulley, making a member of the turner's lathe, of which there are several kinds, as the flat mandrels, which have three or more little pegs or points near the verge, and are used for turning flat boards on; the pin man-

drel are those which have a long wooden shank to fit into a large hole made in the work to be turned; hollow mandrels are those hollow of themselves, and used for turning hollow work; screw mandrels for turning screws, &c.

MANETTIA, in botany, so named from Xavier Manetti, Prefect of the Botanic Garden at Florence; a genus of the Tetrandria Monogynia class and order. Natural order of Contortæ. Rubiaceæ, Jussieu. Essential character: calyx eight-leaved; corolla four-cleft; capsule inferior, two-valved, one-celled; seeds imbricate, orbicular; with a central seedlet. There are three species.

MANGANESE, in chemistry, a substance that has long been employed in the manufacture of glass, on account of its property of depriving that substance of its colour. From its appearance it was called black magnesia, or manganese. It was considered as an ore of iron, because it was found combined with the oxide of that metal. Bergman and Scheele gave an accurate description of its nature and properties. It is generally found in the state of an oxide, either white, or black, or red. The white contains the smallest proportion of iron and of oxygen. This ore soon tarnishes in the air by absorbing oxygen. The red contains more iron than the white, and is crystallized. The black or the brown ore is frequently crystallized like the red. Manganese is procured in the metallic state, by reducing the oxide to powder, and forming it into a paste with water. It is then exposed to a strong heat, not less than 160° of Wedgwood, with charcoal, and the metal, after a time, is found at the bottom of the crucible, or in the midst of the scoriæ in small globules, which amount to nearly one-third of the manganese employed. Manganese, in the metallic state, is of a greyish white colour, with considerable brilliancy, and of a granular texture. The specific gravity is 6.85. It is hard as iron; is one of the most brittle and most infusible of the metals. When exposed to the air it is quickly tarnished, and at length falls into powder, which is found to have acquired considerable addition to its weight. But when heated in the open air it passes more rapidly through the different changes of colour in proportion as it combines with oxygen, to the absorption of which these changes are owing: hence manganese, like some other metals, combines with different portions of oxygen, forming with it different oxides. The different coloured oxides are combined of manganese and oxygen in the following proportions:

	White Oxide.	Brown or Red Oxide.	Black Oxide.
Manganese	80	74	60
Oxygen	20	26	40
	100	100	100

From the black, which is most abundant in oxygen, the chemists usually obtain what they use in their experiments. The black is evidently the metal at the maximum of oxydizement, the white is the one at the minimum. Manganese does not enter into combination with azote, hydrogen, or carbon. By means of charcoal the oxide is reduced, by being deprived of its oxygen. Phosphorus combines very readily with manganese, forming a phosphoret. It may likewise be made to combine with sulphur, forming a sulphuret. It enters into combination with the acids, and forms salts with them. These salts may be decomposed by the alkalies, which throw down precipitates of a yellow or reddish colour. None of them are decomposed by any of the other metals, which shews the strong affinity of manganese to oxygen. The pure alkalies favour the oxydation of manganese, and the decomposition of water, because they combine readily with this oxide. When the black oxide is exposed to heat, with twice its weight of dry soda or potash, a compound is formed of a dark-green colour, which is soluble in water. During the solution, this substance exhibits rapid changes of colour, and on that account has been denominated the "mineral camelion." There is no action between manganese and any of the earths; but its oxide combines with them, and forms vitreous matters, which are of different colours, according to the degree of oxydation of the manganese, and its mixture with iron. The native black oxide of manganese is applied to several purposes. It is the substance from which oxygen can be most economically obtained, large quantities of which are consumed in the formation of the oxy-muriatic acid employed in the art of bleaching. It is used in glass-making to remove from the substance the green colour which is derived from the oxide of iron. The theory of its action is thus explained: iron, in a low state of oxydizement, gives to glass a green tinge, while, if it be at a high degree of oxydizement, it either does not enter into fu-

sion with the ingredients of the glass, or at least does not communicate any colour. Manganese, in the state of black oxide, gives a violet colour, but reduced to the white oxide the glass is colourless. In adding, therefore, the black oxide to glass, while it yields its oxygen to the iron, which it thus brings to a high state of oxydizement, it passes itself to the state of white oxide, and thus each metal is in that state in which it does not communicate colour. The black oxide is also useful, probably by consuming the carbonaceous matter and other substances present in the materials which are susceptible of oxydizement. In large quantities it is used in the composition of ornamental glass, to give a purple colour. It is likewise employed to give a black colour to earthen ware, a quantity of it being mixed with the composition before it it is baked.

MANGIFERA, in botany, *mango-tree*, a genus of the Pentandria Monogynia class and order. Natural order of Terebintaceæ, Jussieu. Essential character: corolla five-petalled; drupe kidney-form. There are three species, of which M. indica, mango-tree, is the most remarkable; it is a large spreading tree; the wood is brittle, and used only for indifferent works; the bark becomes rugged by age; the leaves are seven or eight inches long, and about two broad, terminating in points, having several transverse parallel opposite ribs; the flowers are produced in loose bunches at the ends of the branches; the fruit of this tree, when fully ripe, is yellow and reddish, possessing a fine agreeable juice; some are full of fibres, the juice runs out of these on cutting; but those without fibres are much the finest, they cut like an apple, and are esteemed a very wholesome fruit; excepting pine apples, they are preferable to any other in India: in Europe we have only the unripe fruit brought over in pickle.

MANIS, in natural history, a genus of Mammalia, of the order Bruta. Generic character: no teeth; tongue round and extensile; mouth narrowed into a snout; body covered above with moveable bony scales. These animals greatly resemble the anteater, and feed like that creature by protruding their tongues into the nests of various species of insects, and retracting them with inconceivable suddenness, with their prey attached to the tip. There are three species. M. tetradactyla, the long-tailed manis, has a tail more than twice the length of its body, and is often, in the whole, seen five feet long. Its colour is a dark-brown, with a tinge of yellow, and it displays a very brilliant gloss. It is perfectly covered, except on the belly, with large scales resembling the substance of horn, and which constitute a complete defence for it against its enemies, on whose attack it rolls itself up into a form very nearly globular, presenting on every side impenetrable armour. It is a native of India.

Manis pentadactyla, the short-tailed manis. This is much thicker and shorter than the former, and is covered with scales still thicker and stronger. It is found in many parts of India, and, according to some writers, in Africa, particularly in Guinea. It moves with great slowness, but on imminent danger of attack, rolls itself up with the compactness of a ball, and defies, in this state, the attempts even of some of the larger beasts of prey. It is called in some parts of India the thunderbolt, from the extreme hardness of its scales, which are said to elicit fire from iron, like a flint; and in other parts it is named the stone-vermin, a quantity of stones being generally found in its stomach, supposed to be swallowed by it for the purpose of digesting its food. It frequents marshy and woody places, and lives almost entirely on insects, particularly on ants. It has been seen of the length of even six feet. See Mammalia, Plate XV. fig. 5.

MANISURIS, in botany, a genus of the Polygamia Monoecia class and order. Natural order of Gramina, or Grasses. Essential character: hermaphrodite calyx; glume two-valved, one-flowered, outer valve emarginate at the top and sides; corolla less than the calyx; stamens three; style bifid. Male as in the hermaphrodites; but with the flowers in the lower side of the same spike, standing out more. There are two species, *viz.* M. myurus, and M. granularis, natives of the East and West Indies.

MANNA, the food given by the Almighty to the children of Israel in the wilderness, is the concrete juice of the fraxinus ornus, or flowering ash. The tree is a native of the southern parts of Europe, particularly Sicily and Calabria. Many other trees and shrubs likewise emit a sweet juice, which concretes upon exposure to the air, and may be considered of the manna kind. In Sicily there are three species of fraxinus cultivated for the purpose of procuring manna, and are planted on the declivity of a hill with an eastern aspect. It is full ten years before these trees bear any quantity

of manna; it then exudes spontaneously; but to obtain it more copiously, incisions are made through the bark by means of a sharp crooked instrument; and the season for performing this is in the middle of the summer.

MANOMETER, or MANOSCOPE, an instrument to show or measure the alterations in the rarity or density of the air. The manometer differs from the barometer in this, that the latter only serves to measure the weight of the atmosphere, or of the column of air over it: but the former, the density of the air on which it is found; which density depends not only on the weight of the atmosphere, but also on the action of heat and cold, &c. Authors, however, generally confound the two together; and Mr. Boyle himself gives us a very good manometer of his contrivance, under the name of a statical barometer, consisting of a bubble of thin glass, about the size of an orange, which, being counterpoised when the air was in a mean state of density, by means of a nice pair of scales, sunk when the atmosphere became lighter, and rose as it grew heavier. Other kinds of manometers were made use of by Colonel Roy, in his attempts to correct the errors of the barometer. "They were," says he, "of various lengths, from four to upwards of eight feet: they consisted of straight tubes, whose bores were commonly from one-fifteenth to one-twenty-fifth of an inch in diameter. The capacity of the tube was carefully measured, by making a column of quicksilver, about three or four inches in length, move along it from one end to the other. These spaces were severally marked, with a fine-edged file, on the tubes; and transferred from them to long slips of pasteboard, for the subsequent construction of the scales respectively belonging to each. The bulb, attached to one end of the manometer at the glass-house, was of the form of a pear, whose point being occasionally opened, dry or moist air could be readily admitted, and the bulb sealed again, without any sensible alteration in its capacity. The air was confined by means of a column of quick-silver, long or short, and with the bulb downward or upwards, according to the nature of the proposed experiment. Here it must be observed, that, from the adhesion of the quicksilver to the tube, the instrument will not act truly, except it be in a vertical position; and even then it is necessary to give it a small degree of motion, to bring the quicksilver into its true place, where it will remain in equilibrio, between the exterior pressure of the atmosphere on one side, and the interior elastic force of the confined air on the other. Pounded ice and water were used to fix a freezing point on the tube; and by means of salt and ice, the air was further condensed, generally four, and sometimes five or six degrees below zero. The thermometer and manometer were then placed in a tin vessel among water, which was brought into violent ebullition; where, having remained a sufficient time, and motion being given to the manometer, a boiling point was marked thereon. After this the fire was removed, and the gradual descents of the piece of quicksilver, corresponding to every twenty degrees of temperature in the thermometer, were successively marked on a deal rod applied to the manometer. It is to be observed, that both instruments, while in the water, were in circumstances perfectly similar; that is to say, the ball and bulb were at the bottom of the vessel. In order to be certain that no air had escaped by the side of the quicksilver during the operation, the manometer was frequently placed a second time in melting ice. If the barometer had not altered between the beginning and end of the experiment, the quicksilver always became stationary at or near the first mark. If any sudden change had taken place in the weight of the atmosphere during that interval, the same was noted, and allowance made for it in afterwards proportioning the spaces. Long tubes, with bores truly cylindrical, or of any uniform figure, are scarcely ever met with. Such, however, as were used in these experiments, generally tapered in a pretty regular manner from one end to the other. When the bulb was downwards, and the tube narrowed that way, the column of quicksilver confining the air, lengthened in the lower half of the scale, and augmented the pressure above the mean. In the upper half, the column being shortened, the pressure was diminished below the mean. In this case, the observed spaces both ways from the centre were diminished in the inverse ratio of the heights of the barometer at each space, compared with its mean height. If the bore widened towards the bulb when downwards, the observed spaces, each way from the centre, were augmented in the same inverse ratio; but in the experiments on air less dense than the atmosphere, the bulb being upwards, the same equation was applied with contrary signs; and if any ex-

traordinary irregularity took place in the tube, the corresponding spaces were proportioned both ways from that point, whether high or low, that answered to the mean. The observed and equated manometrical spaces being thus laid down on the pasteboard containing the measures of the tube; the 212° of the thermometer, in exact proportion to the sections of the bore, were constructed alongside of them: hence the coincidences with each other were easily seen; and the number of thermometrical degrees answering to each manometrical space, readily transferred into a table prepared for the purpose."

MANOR, was a district of ground held by lords or great personages, who kept in their own hands so much land as was necessary for the use of their families, which were called demesne lands, being occupied by the lord, or *dominus manerii*, and his servants. The other lands they distributed among their tenants, which the tenants held under various services. The residue of the manor being uncultivated, was termed the lord's waste, and served for common of pasture to the lord and his tenants. All manors existing at this day must have existed as early as King Edward I., and must have a Court Baron.

MANTELETS, in the art of war, a kind of moveable parapets, made of planks about three inches thick, nailed one over another, to the height of almost six feet, generally cased with tin, and set upon little wheels, so that in a siege they may be driven before the pioneers, and serve as blinds to shelter them from the enemy's small shot.

MANTICORA, in natural history, a genus of insects of the order Coleoptera: antennæ filiform, the joints cylindrical; four feelers, filiform; thorax rounded before, emarginate behind; head projecting; mandibles exserted; shells united without wings. There is but a single species, *viz.* M. maxillosa, that inhabits the Cape of Good Hope.

MANTIS, in natural history, a genus of insects of the order Hemiptera. Head unsteady; mouth armed with jaws; feelers filiform; four wings, membranaceous, convolute, the under ones plaited; fore legs compressed, serrate or toothed beneath; armed with a single claw and lateral-jointed process; the four hind ones smooth, and formed for walking; thorax (usually linear) elongated, and narrow. There are upwards of sixty species: the chief is M. oratoria, or camel-cricket, which is found in the southern parts of Europe, and is entirely of a beautiful green colour. It is nearly three inches in length, of a slender shape, and in its general sitting-posture, is observed to hold up the two fore legs, as if in the act of devotion: hence it has been regarded as sacred, and a notion has prevailed, that a traveller having lost his way would be safely directed by observing the quarter to which the animal pointed when taken in the hand. This insect is of a predacious disposition, living on smaller insects, which it watches for with great anxiety; it is also quarrelsome, and when kept with others of its own species in a state of captivity, they will attack each other with the utmost violence, till one is destroyed. The conqueror devours his antagonist. M. precaria is said to be the idol of the Hottentots.

MANUFACTURE *of cotton.* To this article we referred from the word COTTON, having been deprived, by accident, of the information which we are now enabled to lay before the public on this interesting part of English manufactures.

We shall begin with the description of the fabrication of cotton yarn by the spinning jenny, both because of its more ancient use, and as it leads best to the general knowledge of the manufacture.

Preparation of the Cotton-wool. The raw cotton is imported in large bales, compressed very closely together by engines, and contains the seeds of the plant mixed through it in considerable quantities, together with more or less foreign matter, from which it must be freed: for this purpose it is in general sufficient to beat it well with sticks, by which it undergoes a process similar to the threshing of corn. This is usually performed on a frame, similar to a table, the upper surface of which is formed by small cords stretched tightly across, nearly in contact, the elasticity of which assists the operation, while their intervals afford a free passage for the separation of the seeds and other substances in the cotton. In this process the cotton recovers its original volume, and loses the hard consistence into which it had been pressed in the bales.

Picking Engine. An engine has been contrived to render this operation more perfect, which is used in some manufactories: this consists of two revolving fluted rollers of metal, about an inch in diameter, and sixteen inches long, placed horizontally one over the other; a kind of comb of steel in the same direction moves before these rollers,

with a quicker motion up and down, very close to the rollers, so as to catch and draw out the cotton as it passes forwards between them: underneath an oblong sieve of wire moves back and forwards horizontally, which catches the cotton as it falls from the comb, and frees it from the loose seeds and other matters: above, a sort of frame, like a table, lies behind the rollers, over which an endless cloth is contrived to pass continually, so as to come in one part very close to the rollers; on the upper surface of this cloth the cotton is spread by hand evenly, and thus is brought forward by degrees to the rollers, which deliver it to the comb, as already described.

Another engine of coarser operation is sometimes used previous to the above. This is formed by an oblong roller, three or four feet long, and about fourteen inches diameter, having longitudinal rows of spikes, of three inches long, at intervals of four or five inches, projecting from its surface. This roller revolves within a hollow cylinder, furnished in like manner with rows of spikes projecting inwards, so that the spikes of the internal roller may pass between them: both roller and case are formed usually of bars of wood, so as to leave free space for the cotton to pass, and the dirt to fly out.

Where these engines are not used, or when they are not sufficiently perfect to completely free the cotton from its seeds and foreign matters, the cotton wool is afterwards carefully picked by women and children, who remove whatever matters might remain in it after the former operations.

When the picking is completed, the cotton next undergoes the process of washing with soap, which not only cleanses it from dirt adhering to its fibres, but it is thought has also a sort of chemical action on it, in making the fibres more tortuous and spiral, by which in a great measure the yarn formed from it acquires that elastic softness, which peculiarly distinguishes it from that spun in mills, which latter does not usually undergo this operation, and which fits it so well to form the weft of cotton cloth, while the superior firmness and hardness of the mill-twist qualifies it better for the part of the warp for which it is generally employed.

After being thus washed, the cotton is next carried to the press, where most of the water which it has imbibed is forced out of it: in this operation it is generally put into a strong wooden box, perforated with holes at every side, and open at top; a wooden cover is then put over it, sufficiently small to enter the box; the whole being then put into the press, the cover is forced down by a wooden screw. Nothing made of iron should be used about the cotton while it is wet, as it might impart a stain hard to be removed.

When the cotton is sufficiently pressed, it is spread on canvass, or railed wooden frames, and brought to the stove to be dried.

The stove consists of a chamber, of size proportionate to the work to be done in it, which is usually arched over with brick, and separate from the other buildings of the cotton factory, to prevent accidents by fire; a flue of cast-iron runs through the middle of this chamber, a little above the floor, from a fire place, which opens outside. In some stoves inverted pots, or metallic cylinders, are fixed at intervals along the flue, with which they communicate beneath; wooden supports are placed round the sides of the stove to sustain the frames, on which the damp cotton is spread, which is left to remain here till it is thoroughly dry. As the stove may be constructed in various manners, without any material difference in its performance taking place, it is probable that many other constructions are used in different places; but the one described is of a kind in very general use, and has no very obvious defect. It is probable a stream of heated air conveyed through the stove might be an improvement, tending to accelerate the drying process; as it is very obvious, that when the air contained in the stove becomes loaded with moisture, it cannot absorb that of the cotton very readily. Double doors should also be added to stoves, with a small space between them; and one door should always be shut again before the other was opened, to prevent the cooling of the stove, by the whole mass of heated air passing out at once, which must frequently take place in stoves with single doors.

Carding Engine for Jenny-spinning. When the cotton is sufficiently dry, the next operation which it undergoes is that of carding. This is performed on an engine which has now been brought to great perfection, of which, and of the manner in which it is used, the following is a description. The cotton is first spread on a feeding cloth, disposed in the same manner as that already described for the same purpose in the picking engine; two

small rollers, about an inch in diameter take up the cotton between them as it successively approaches them on the revolving cloth, and deliver it to a roller of from twelve to eighteen inches diameter, according to the size of the engine, covered with cards of the fineness proper for cotton: (cards for the operation of carding cotton or wool by hand being used in most towns and villages, need not be described here, and will also be found under their proper head): from this roller the cotton passes to another of about the same size, from whence it is delivered to the great carding roller, which is from two to three feet in diameter: about the upper half of this roller several small rollers are placed, of three or four inches diameter, between which and the great roller the cotton is carded, as well as between those of a larger size: another roller, of from twelve to eighteen inches diameter, takes the cotton from the large roller, and is again stripped of it by a kind of comb, with very short teeth of iron, which moving up and down before the roller, strikes the cards in its descent in the direction of their teeth, by which the cotton is separated in a fine thin sheet, like a fleece, in which it passes between a smooth roller (which is mostly covered with fine paper), and a hollow semi-cylinder, that form it into oblong rolls, similar to those made by hand-carding, but much longer: on the surface of the smooth roller are small projections, parallel to the axis, at the distance of four or five inches from each other; which rolling the cotton between them and the semi-cylinder beneath, produce the effect described. These projections are formed in many engines by whipcord stretched tightly across in the proper places, before the paper is pasted on, which covers both them and the roller.

When the cotton is thus formed into rolls, it falls into a receptacle, whence it is taken to be slubbed.

It is to be understood, that the operation of carding performed by the several rollers described is effected by each successively moving faster than the one behind it, and of course slower than the one before it, with the exception of the small rollers placed above the great roller, which move with an uniform velocity, and all much slower than the large roller. In some carding engines formerly a good deal of the motions were performed by toothed wheels and pinions, but of late years they are effected by bands, or straps, which produce a much more equable and steady movement. The large rollers are generally made by placing two or more wheels of cast iron on one axle, the circumferences of which wheels are cased with wood, which is attached to them by screws or rivets: the smaller rollers are formed in a similar manner on wooden disks; but all are made hollow to prevent warping.

Slubbing. When the cotton is carded, the long rolls into which it is formed are next drawn out into a thick coarse thread, of loose texture, and but little twisted, called the slubbing. This operation is generally performed by hand, on the common hand wheel, which is similar to that used for spinning wool, but of a smaller size. Engines have been contrived by which a number of slubbings could be drawn out together; but the hands required for joining the rolls of cotton in succession, and for other purposes about those engines, were found to be so many, that very little, if any, saving was made by those machines.

Robing. The slubbing coiled into conoidal rolls, called cops, are next brought to the engine called the robing billy, by which it is drawn out into a finer thread of the same loose texture as before, receiving at the same time a little more twist.

The Robing Billy. This machine is contrived to give circular motion to a number of spindles, and at the same time draw out the slubbing which is attached to them to a finer thread. The spindles are placed in a frame, so as to stand nearly perpendicularly at about four inches from each other; their lower extremities turn in sockets, and small collars of brass sustain them about half way up: their upper halves project above the frame: to their lower parts are attached small pullies, or whirls, from whence bands pass to a horizontal cylinder of about six inches diameter, a little longer than the row of spindles, which is placed before them at a lower position, and which gives motion to all the spindles together when it is turned round. This cylinder is now almost universally made of tin plate; wooden ones of the same dimensions, however carefully made, having been found liable to warp and lose their proper shape. To prevent the bands from slipping, coarse paper is pasted over the tin, which answers the purpose very effectually. The cylinder receives its motion from a wheel, (like the large wheel used in spinning wool by hand, and of the same dimensions), with which it communicates by a band: this wheel is turned by the hand directly, by means of a winch.

In front of the spindles, about a foot higher than their tops, a long spar of deal is supported at each extremity by a pair of small wheels, or sheeves, which run on the sides of the frame in a kind of grooves, so as to admit of the spar being moved back and forwards about six or seven feet, in a horizontal position, without varying from its parallelism to the row of spindles; the bottom of this spar is formed into oblong narrow grooves, into which projecting parts from a lower spar suspended beneath it fit accurately. This lower spar is confined by a sort of staples, so as to admit only of a motion up and down of a few inches below the upper spar, along with which it is drawn back and forwards: the up and down motion is given by a number of small cords at about three feet asunder, which pass from it, over small pulleys in the substance of the upper spar, to a thick wire that lies above it; which wire is moved by a cord going round a pulley of about six inches diameter, supported at the middle of the upper spar: to this pulley an handle is fixed, which, on being pressed down over a spring clasp, raises up the lower spar close to the upper one, and retains it in that position: when the spring clasp is pressed back from the handle, the weight of the lower spar causes it to fall down clear of the upper one. The use of this arrangement of the two spars is to hold fast the slubbings, which are passed between them on to the spindles. The cops of slubbings are supported on a frame, which lies below the moveable spars; small rods pass through them, and through holes in the frame, which sustain them in an upright position, at about the same distance from each other as the spindles.

When the robing billy is worked, the slubbings are first drawn between the moveable spars, and each fastened to its corresponding spindle: a sufficiency of length of the slubbings is left between the spars and the spindles to allow for five or six feet of robing to be drawn out of each, which is regulated by a mark on the frame, that shews when the moveable spars going from the spindles have come to the proper position: the spars are then closed by pressing down the handle under the clasp, the spindles are put in motion by turning round the large wheel, and at the same time the moveable spars are drawn back gently: by this means, as the slubbings are drawn out they get proportionally more twist, so as to keep them from breaking; and when they are drawn to the intended extent, by the spars being moved back to the extremity of their supports, a few turns of the wheel gives them all the twist that portion of them is intended to have. The robings now formed between the spars and the spindles are guided to that part of their respective spindles where they are to remain; and the spindles being again put in motion, while the spars are pushed forwards towards them; the part formed of the robings are by this means rolled up on the spindles. The handle is then released, the lower spar falls down, the spars are drawn back to the mark, which shews that the proper length of slubbing has passed between them; the spars are again closed, and the operation repeated as before described. The robings are guided to the parts of the spindles where they are to be coiled up, by a long horizontal slip of deal, which is supported over them close to the front of the spindles by a light frame, hung on two pivots, that admit of its moving the length of the spindles up and down: a cord is stretched from this frame, near the pivot, along one of the supports of the moveable spars, and passes between three small pulleys at the extremity of the spar: two of the pulleys being at the side of it next the spar, and the middle pulley being outside: this last pulley is fastened to a slide, which is drawn back by a string that runs along the spar to its centre, where it passes over a grooved segment of a small wheel, with a small projection; which, being pressed down by the finger, draws the cord in, which causing the stretched cord to contract in length between the pulleys, forces the deal slip down on the robings, and guides them to the parts of the spindles where they are to remain: a small counterpoise draws off the slip, when the finger is removed, and restores this part of the apparatus to its first position.

Of Spinning, and the Spinning Jenny. When the robings are finished, they are brought to the spinning jenny to complete the spining. The spinning jenny is an engine on the same principle as the robing billy, and only differs from it in having smaller spindles, more in number, and closer together: the cops of robings are placed in it, as those of slubbings are in the billy, and by a similar management and operation are drawn out into the required fineness, and receive the degree of twist which forms them into cotton yarn.

Reeling. The cotton yarn, when taken from the jenny, is reeled to ascertain its

degree of fineness, and then laid by with others of the same sort: the reel used is a small wheel reel, which denotes the completion of the bank, or given number of yards, by a spring that slaps against its frame at that instant: its machinery is the simplest used, and not different materially from the wheel reels common in other manufactures.

The cotton yarn spun on jennys is almost solely used for weft, which, from its superior softness, it is peculiarly fitted for, which softness is indispensably requisite for some fabrics. As yet no way has been found of forming yarn by mill spinning of the same quality in this respect, and therefore the mill-yarn is almost entirely appropriated for warp. This material difference originates in the carding, which in that for the jennys lays the fibre of the cotton across the roll, while the carding engine for the mill-spinning lays the fibre longitudinally in the direction in which it is afterwards spun, as will be more plain from the following description of this operation.

Of Mill Spinning. The cotton for mill spinning is cleared and beaten in a similar manner to that for jenny spinning, but is not washed or stoved; after it is judged to be sufficiently clean, it is brought to the carding engine.

Mill Carding Engine. The principle on which this engine is constructed, are the same as those on which the carding engine for jenny spinning is formed: the great point in which they differ is, in the manner in which the carded cotton is taken from them, which, in the mill engine, is so as to form an entire flake, or continued sheet, of the breadth of the last cylinder; the cards on this cylinder are generally formed of long narrow stripes, about an inch and a half broad, and are put on round it spirally, by which means there are no joinings in the longitudinal direction of the cylinder of any considerable length. The carded cotton is struck off this cylinder in the same way as from the other engine; but instead of being passed under the roller with longitudinal projections, to form it into rolls, it is drawn forward through a conical guide of tin, by two narrow wooden rollers, about six inches in diameter, that deliver it into deep and narrow tin vessels, in the form of a long ribband, about two inches in breadth. The mill engine, instead of the small carding rollers above the main cylinder, used in the jenny carding engine, has commonly narrow flat spars of deal with cards attached to them, fixed at a proper distance from the principle cylinder. Toothed wheels and pinions are more used in the mill carding engine than bands; but that this is any improvement is doubtful, as in other parts of the machinery of mills, bands have been substituted for wheel work to advantage, and probably will be more so than they are now, as they work without causing that shaking motion which toothed wheels occasion in general, and which is both injurious to the evenness of the yarn, and the duration of the machinery. For toothed wheels, when in quick motion, act by a succession of percussions on each other, unless constructed with an accuracy as to the form of the teeth, that is very difficult to give to very small wheels, or unless the teeth are so numerous that several may come in contact at once, which in small wheels would cause them to be of too reduced a size, and too weak for mill work.

From the carding engine the long stripes of carded cotton are brought to engines consisting merely of two pair of small rollers, one pair of which moves faster than the other, and each pair of which are caused to press against each other with some force, either by weights or springs. Here two, three, or more of the stripes of carded cotton are drawn out together into another stripe, smaller than the first stripes, and this operation is repeated till the stripes attain that evenness which is so essential to the formation of good twist.

Of Mill Slubbing. The prepared stripes of carded cotton are then brought to the slubbing engine, where they are formed into a thread of very loose texture and little twist.

The slubbing engine consists of two pair of drawing rollers between which the prepared stripes of carded cotton are drawn out to the required fineness, they then pass downwards into tin cylinders, which revolve with a velocity proportionate to the twist to be given; at the top of each cylinder two very small rollers are placed, which are made to turn round by bands passing down the sides of the tin cylinder, over small pullies, to a fixed wheel at bottom; these small rollers draw down the narrow stripes of cotton into the cylinders, and the centrifugal motion distributes them equally round the sides of each cylinder in a long hollow roll, which is taken out at a door at the side of the cylinder, that is fastened with a hook and loop.

The slubbing is then rolled on bobbins,

by hand, by children or women, by a very simple method, which both prevents its breaking, and causes it to be rolled on the bobbins with equal tightness in every part. The bobbin lies on the top of a narrow cylinder of wood, that just fits in between its two extremities, and which is about eight or ten inches in diameter: a wire is passed through the bobbin into the frame, each extremity of which has a vertical groove, that sustains it in its place; the cylinder is turned round by a winch, and as the slubbing rolls on the bobbin, still turns it round with equal velocity, as it is against the surface of the rolled cotton alone that it acts.

The Spinning Frames. When the stubbing is rolled on the bobbins, it is then prepared for spinning, and brought to the spinning frames for that purpose; where the bobbins are placed in rows above the frames in a sort of vertical rack prepared for them, and are kept in their places there, by thick wires which pass through them, on the points of which they revolve as the slubbing is drawn off them by the spinning apparatus, which consists principally of three pair of small rollers, which draw out the slubbing to the proper fineness, and of the fly and bobbin which gives it the due degree of twist, and rolls it up when spun. The three lower rollers are of steel, fluted or grooved longitudinally at small intervals, and are about an inch diameter. The upper rollers are of wood with iron axles, and are covered first with cloth and then with glove leather, and rubbed well with chalk. Every steel roller is divided into as many intervals, of about an inch and a half long, as the number of threads to be drawn by it amount to, which is seldom more than six. The covered rollers are in lengths of two of those intervals, and each press on two of the slubbings; the extremities of their axis move in pieces of iron with vertical grooves, that admit them to press downward freely, but prevent all lateral motion; the middle of the axis, as well as the ends, are turned in a lathe, and from it, by a hook, depends a weight that presses it against the steel roller that lies beneath. Springs are used also to give the same pressure, and where they can be regulated so as to give exactly the same pressure to each roller used, are preferable to weights, which, from the number wanted, are a considerable load to the floors of the spinning mill, and by all getting into a vibratory motion when at work, very much shake the building. The steel rollers have, at their extremities, small toothed wheels of brass, which are connected with other wheels, and pinions at the side of the frames, so regulated by the number of their teeth, that the second roller goes round faster than the first, and the third faster than the second. The covered rollers are each moved by the steel rollers on which they press, and by this means the slubbing is drawn out twice successively before it passes to the fly. The spinning part, for each thread consists of a spindle placed vertically, which sustains the fly and the bobbin. The fly is a steel wire bent round from the top of the spindle, so that a small ring at its extremity may be about an inch and a quarter from the spindle outwards, and the length of the bobbin below its top, to which it screws on by a small ferule: through the ring the twisting slubbing passes to the bobbin, whose office is merely to roll up the twist as it is spun by the swift revolutions of the spindle; the bobbin is about three inches long, and is perforated longitudinally, so as to permit the spindle to turn round freely within it. That the twist may be rolled up equally on every part of the bobbin, it is necessary that the bobbin should be moved up and down on the spindle with a slow motion; for this purpose all the bobbins in the large frame rest on a horizontal bar of wood, moved up and down by two arms suspended on centres that receive this motion from the revolutions of an heart wheel, or wheel of an oval form. The weight of each of the bobbins pressing it on this bar prevents its being turned round by the spindle, and this resistance causes the fly to wind the twist on it by degrees, gently pulling it round in proportion as the circumference of the bobbin exceeds the length of twist spun in each revolution of the fly. The six spindles which answer to the six divisions of the steel rollers, are turned round by bands, which pass round an horizontal drum, the axis of which ascends upwards, and gives motion to the fluted rollers by a pinion on its top; this axis receives its motion from other bands, which pass to large drums turned by horizontal shafts, running the whole length of the spinning rooms, which ultimately receive their motion from the water wheel, or other primary moving power.

Several sets of the rollers, with their spindles, are fixed in one wooden frame; the spindles are all outside, and the wooden frames are generally double, to contain two rows of the frames of rollers, by which

they take up less space. The spindles are divided, as described, to correspond with the rollers, that when any thread breaks, not more of them may be stopped than this small number. Each set of rollers, and their attendant spindles, are stopped instantly by raising a little socket turning on the upright axis, which elevates a small vertical bolt that passes through the small drum to a projecting arm on the lower part of the axis; above which arm, when this bolt is raised, the communication between the drum and the axis ceases, and the drum remains at rest, while the axis revolves within it uninterrupted.

By similar contrivances the drum, which gives motion to all the small drums in one wooden frame, can be stopped at pleasure. Each horizontal shaft, which sets the large drums of a whole room in motion, may also be stopped at pleasure, and this system pervades the whole mill, by which means, when any one part becomes damaged, it may be stopped without interrupting the motion of the rest.

In some mills, instead of the large drums, toothed wheels are placed, which impel round small shafts, that pass beneath the frames, where, by corresponding wheels, they turn small toothed wheels on every upright axis beneath each small drum; but the motion given by the large drums and bands, is accounted to be more steady and uniform than that thus produced.

The general machinery of the cotton mill, by which the various engines described are set in motion, is as follows: The moving power, whether a fall of water, or a steam engine, is, by intervening wheels, adapted to its nature, made to turn round a vertical shaft, which passes through all the stories or floors of which the mill consists; in each of which it is furnished with a horizontal toothed wheel, which gives motion to a vertical wheel, to which is attached a horizontal shaft going across one end of the floor, which gives motion to two or more other horizontal shafts, according to the breadth of the building, which run the whole length of the story; these give motion again to small vertical shafts, which sustain the large drums that set the spinning frames in motion. The horizontal shafts have also drums on them, from whence bands proceed, by which the carding engines, and slubbing machines are turned. What is said of the general arrangement of the mill work can only be understood in a general sense, for the number and position of the horizontal shafts, set in motion by the vertical shaft, must vary according to the nature of the buildings, and the disposition of the frames in each floor of them. Where it can be done, it is best to have the vertical shaft placed in the middle of the building, with the horizontal shafts proceeding from both sides of it at every floor, for thus the horizontal shafts sustain less of that twisting motion, which is very injurious to them, and to which they would be more liable if of the whole length of the building.

The spinning frames are attended by children, to piece the threads when they break, and the whole attendance of the various engines is for the most part performed by children also. The numbers employed of persons of this tender age in some large mills amount to some hundreds.

Some of the great cotton mills were worked incessantly night and day, and different sets of children relieved each other in succession in attending them. This system was found to be very injurious to the children. An act of parliament was passed enforcing salutary regulations on these points, which has been warmly seconded by the humane proprietors of some of the most eminent mills; who have their buildings now well ventilated and warmed, (by means contrived by gentlemen best skilled in such matters) have them kept constantly clean and sweet by obvious methods, and have not only the health of the children further preserved by proper attention to their food, clothing, and personal cleanliness; but also have them taught to read and write, and take care that they receive instructions as to their morals and religion; both of which were shamefully neglected in former times. All that remains to be wished now on this head is, that in those situations, where avaricious masters wish to evade the act, or do not choose to pay proper attention to the children in other respects, that humane people may be found who will interpose, and compel them to do their duty, and either by Sunday schools, or other proper means, effect that the children may receive those instructions, without which they can never be worthy members of society.

After the cotton is spun, it is usually made up into warps fit for the weavers before it leaves the mills; this operation is performed on the following engine:

The Warping Mill. The warping mill consists of a light frame-work, which forms the outline of an octagonal prism, or one

of more numerous sides, about six feet diameter, and seven feet high, that is turned round on a vertical axis by a band, that passes from a grooved wheel on the axis, to another grooved wheel that is turned by a winch, and is placed under the seat on which the warper sits; the bobbins which sustain the twist are placed on a vertical rack suspended from the ceiling, and the threads from them pass between two small upright rollers, on a piece of wood which slides perpendicularly along an upright bar, fixed at one side of the revolving frame; a small cord passes, from a part of the axis that rises above the frame, over a pulley at the top of the fixed bar, down to the sliding guide, which it slowly draws up, by coiling round the axis as the frame turns round; by which means the yarn is wound spirally about the frame, to the length which the warp is required; to which extent, when the yarn arrives, it is crossed on pins projecting from the frame, and the mill is turned the reverse way; by which the slide descends, and the yarn is laid along the same spiral downwards, along which it before ascended.

When the warp is completed to the number of threads required for the web, for which it is intended, it is taken off the mills, and wound up into a ball, the crossings being first properly secured for the use of the weaver: and in this state it is sold to the weaving manufacturer, when the mill-owner is not concerned in this branch of business himself.

Of Weaving. A vast variety of fabrics are formed of cotton; every species made of linen or silk has been successfully imitated with it; and the velverets and thick cords made of it, have been found to answer for many purposes in place of woollen cloth. The finest muslins of India do not exceed those which are made in this country; and the richness of colour, and variety of figure, of the chintzes of the East, are now surpassed by those of our printed cottons: from the excellence of these goods, and the low prices at which the extensive use of machinery allows them to be sold, the exportation has become prodigious; and the comforts of the lower classes at home are considerably encreased, from the cheap rate at which they can procure most articles of clothing of this kind.

There is no mode of weaving peculiar to cotton, so that on this head we must refer to the article WEAVING for information; as every cotton stuff is woven in a way resembling that of some other fabric, unless we may except that called Marseilles; though stuffs may be made of linen or silk, or a mixture of linen and woollen, in a similar manner to that in which this is formed.

The loom for weaving Marseilles is somewhat similar to the diaper loom. A good idea of the manner in which it is prepared, may be had, by conceiving two webs woven one under the other in the same loom, which are made to intermingle at all the depressed lines, which form the reticulations on the surface, in imitation of the quilting performed by hand.

When the species of Marseilles, called Marseilles quilting, is made, a third warp, of softer materials than the two others described, lies between them, and merely serves as a sort of stuffing to the hollow squares formed by them.

Another sort of cotton stuff, solely appropriated to quilts, should, in strictness, be set down exclusively to the cotton manufacture; though there is nothing to prevent its being made of other materials. The weft of those quilts is of very coarse and thick yarn, which is drawn out by a small hook into little loops, as it is woven, that are so arranged, as altogether to form a regular pattern; every third or fourth shoot of the shuttle, the weaver has to stop to form those loops from a draft, which causes the weaving of those quilts to take up more time than that of any other stuff, except tapistry; which accounts for the greatness of the price at which they are sold, in proportion to the value of the materials of which they are principally composed.

Before concluding the head of weaving, it will be proper to notice a considerable improvement added to one of the principal implements for this operation, which first originated in the cotton manufacture; which is a very simple apparatus attached to the batton, by which the shuttle is thrown through the warp without requiring to be touched by the hand; as it may be set in motion both ways by the same hand, the weaver saves the time that is lost in shifting hands in the common way of weaving; and from this cause, added to other circumstances, is enabled to weave a considerable quantity more in a day by the use of this contrivance; and, which is in reality still more material to him, by enabling him to sit at his work in an erect posture, prevents that frequent stooping forwards, and consequent pressure on the chest, which was found to be so extremely unwholesome in this business, that a very great proportion of weavers died annually of complaints on

the lungs, originating from this circumstance alone.

The Fly Shuttle. The apparatus by which this is effected is known by the appellation of the fly-shuttle, or flying shuttle, (probably from the swiftness of the motion of the shuttle, when it is used). It consists of a little oblong trough, attached to each side of the batton in front, so that the end of each shall lie exactly opposite to the aperture formed in the warp for passing the shuttle, when the treadles are pressed down; a small cubic piece of wood, usually covered with hard leather, slides back and forwards in each trough, and is retained within it by a thick wire, which runs through its upper part, and proceeds from the further end of the trough, which has a button, or knob, on the end next the web, that prevents the little wooden cube from slipping off; from the moveable cube in one trough, a cord proceeds loosely over the web to that in the opposite trough, and a turned handle is attached to the middle of this cord, by which the weaver puts the little cubes in motion; the shuttle is straight-sided, and is sloped off to a point at both ends, which are tipped with iron; very light and well-turned little wheels are let into the substance of the shuttle at each end, and project little more than the eighth of an inch beyond its surface; and on these it runs along the lower rail of the batton, over the lower threads of the warp when it is thrown. When the weaver works with this apparatus he first presses back one of the sliding cubes to the further end of the trough in which it lies, and lays the shuttle in the trough directly between it and the web, first fastening the end of the yarn contained by the shuttle properly to the web; then pressing down the treadle, he takes up the handle which puts the sliding cubes in motion, and by a gentle jerk of his hand pulls the cube, which is behind the shuttle, towards the web; the quick motion of the sliding cube is directly communicated to the shuttle, and it flies rapidly through the warp into the trough at the other side, pressing back the contrained sliding cube as it passes to its end; from whence a slight motion of the hand in the opposite direction impels it back again to its first position, after the thread shot in has been beaten up close to the web, and the warp been opened again ready to receive another course.

The apparatus described is now in general use, in most other manufactures, and is found to be particularly advantageous in weaving broad cloths, carpets, and other goods of great breadth, which formerly required two men to each loom, merely to throw the shuttle.

In places where it is not yet introduced, it evidently would be an object of humanity to induce the weavers to use it, on account of the beneficial effects it has on their health.

Burning. When the webs are taken from the looms they are covered with an irregular down or knap, from the projection of the short fibres of the cotton wool, which is removed by passing the webs over a red-hot iron plate, that burns it off.

The apparatus for this operation consists of an iron semi-cylinder, set horizontally in brick-work, having a fire-place under it with an iron door through which fuel may be introduced; at each side of this is placed a light wooden roller of rail-work, turning freely on an iron axis by a winch; from the same uprights which support these rollers, are suspended light frames at each side, which turn on pivots in their centres, by depressing the further ends of which, the cords next the stove raise up a rail, which runs across near the iron semi-cylinder, and which mostly consists of a slight iron rod.

After the fire placed beneath the iron-burner has made it red hot, the web, whose surface is to be burned, is rolled up on one of these cylinders, and the end of it is passed over the lifters and hot iron, to the other cylinder; a man stands at each cylinder, and the instant the one at the empty cylinder begins to turn, the lifters are lowered, so as to let the web come in contact with the red-hot iron; by which means, its whole surface is drawn over the iron, with that degree of velocity which is just sufficient to burn off the loose filaments, without injuring its fabric. The very finest muslins undergo this operation, and though they are so thin, that the least deviation from the proper velocity, in passing them over the iron, causes them to be burned through, yet there very seldom happens any accident to them, which shews that this process is more hazardous in appearance than reality.

After burning, the webs are all bleached, to remove the dark colour given them by the fire; and when of a proper whiteness, those which are designed for dying or printing are sent to the respective artists in those lines, and the rest are made up for sale as they are.

The operation of printing has arrived to

great perfection, and the process of bleaching is well worthy of attention; but for these we must refer to their proper heads.

In concluding the account of the cotton manufacture, it may not be unacceptable to give some short relation of the manner in which it is carried on in India, where it existed, and produced an extensive commerce, for ages before it was thought of in Europe.

The manner of manufacturing cotton in India forms a remarkable contrast to the European method. In Europe, a vast apparatus of machinery is used in every part of the process, while in India the simplest instruments are made to produce fabrics of that exquisite fineness, which it is the boast of our manufacturers to imitate, and which as yet they can scarcely equal. The cotton wool in India is prepared for the spinner without cards, is spun for the weaver without wheels, and is woven in looms without any frame-work, which the weaver can move from one place to another, with as much facility as the web itself.

The operation which our manufacturers perform by carding engines, is executed by the Indian with nothing more than a bow; the percussions of whose string snapped over the cotton wool in repeated vibrations, raises it to a fine downy fleece; in this same way our hatters prepare their furs for felting, an operation which may be seen in most towns.

The fine thread, or yarn, from which the choicest muslins are made, are spun from cotton thus prepared, by the distaff and spindle, a mode which it is evident was practised by the Romans, Greeks, and Egyptians, from their history, their fables, and their sculptures, and than which nothing can be more simple; this yarn is then wove on the following loom, the account of which is abridged from that of an eminent writer on Indian affairs.

Indian Loom. The Indian loom consists merely of two bamboo-rollers, one for the warp, and the other for the web, and a pair of geer; the shuttle performs the double office of shuttle and batton, and for this purpose is made like a large netting needle, and of a length somewhat exceeding the breadth of the piece.

This apparatus the weaver carries to whatever tree affords a shade most grateful to him, under which he digs a hole large enough to contain his legs, and the lower part of the geer; he then stretches his warp by fastening his bamboo rollers at a due distance from each other on the turf by wooden pins; the balances of the geer he fastens to some convenient branch of the tree over his head; two loops underneath the geer, in which he inserts his great toes, serve instead of treadles; and his long shuttle, which performs also the office of a batton, draws the weft, throws the warp, and afterwards strikes it up close to the web: in such looms as this are made those admirable muslins whose delicate texture the European could never equal with all his complicated machinery.

MANUFACTURES may be defined, the arts by which natural productions are brought into the state or form in which they are consumed or used. The principal manufactures are those which fabricate the various articles of clothing; as the woollen-manufacture, the leather-manufacture in part, the cotton-manufacture, the linen-manufacture, and the silk-manufacture; others supply articles of household furniture, as the manufactures of glass, porcelain, earthenware, and of most of the metals in part; the iron-manufacture furnishes implements of agriculture, and weapons of war; and the paper-manufacture supplies a material for communicating ideas and perpetuating knowledge. Manufactures had begun to flourish in different parts of Europe, long before they were attempted in Britain; the few articles of this description which were in request, being obtained in exchange for wool, hides, tin, and such other produce as the country in a very uncultivated state could supply. In 1337, it was enacted, that no more wool should be exported; that no one should wear any but English cloth; that no cloths made beyond seas should be imported; that foreign clothworkers might come into the King's dominions, and should have such franchises as might suffice them. Before this time, the English were little more than shepherds, and wool-sellers. The progress of improvement since the establishment of manufactures in this country, has in most instances been remarkably great, particularly of late years, in consequence of an increased knowlege of the properties of various materials, vast improvements in all kinds of machinery, and the great capitals invested in most of the different branches. The value of British manufactures exported to all countries, on an average of six years, ending with 1774, was 10,342,019*l.*; the American war suspended for a time an important market for

several of our manufactures, in consequence of which the total amount exported had fallen in 1781 to 7,633,332*l.* and on an average of six years, ending with 1783, it was 8,616,660*l.* During the peace which followed, the export trade rapidly revived, and, in the year preceding the war with France, had attained to a magnitude beyond all former example; it was checked a little by the mercantile embarrassments in 1793, but a few years after the unsettled state of several of the principal European powers threw many additional branches of foreign trade into the hands of our merchants, and carried the export of our manufactures to its present important extent. The real value of British produce and manufactures exported, as far as it can be ascertained, under the ad valorem duties, or computed at the average current prices of the goods, amounts to more than forty millions sterling. The woollen-manufacture, which is the most ancient and important, has increased during the last twenty years, and appears to be still increasing, notwithstanding the high price of the material, and the precarious state of the foreign markets. On an examination of the principal woollen-manufactures, by a committee of the House of Commons, it was estimated the quantity of wool grown in this country at 600,000 packs, of 240 pounds each, which at 11*l.* per pack, makes the value of the whole 6,600,000*l.* But it was justly observed that it is difficult to ascertain how much the wool is increased in value by being manufactured; some sorts are increased rather more than double, some nine times or even more; but if the average is taken at only three times, which will be under the truth, the total value of the wool manufactured in the country will amount to 19,800,000*l.* It must be remarked, that this calculation is founded on a supposition that, in 1791, the number of sheep in the kingdom was 28,800,000, which, as far as any idea can be formed from the proportion of the consumption of the metropolis, to that of the whole island, and the stock requisite for the supply, greatly exceeded the truth at that time; and it is the general opinion, particularly of persons in the wool-trade, that of late the number of sheep kept has been considerably reduced.

The calculation is likewise made at an unusually high price of wool; for though during the year 1800, the average price was about eleven guineas, the average of the three or four preceding years was certainly not more than from ten pounds to ten guineas; upon the whole, the estimate, therefore, will be much less objectionable, if formed on 500,000 packs at 10*l.* 10*s.* per pack, which will make the value of the wool 5,250,000*l.*; to this must be added at least 500,000*l.* for the value of Spanish wool imported, and the manufactured value of the whole will be 17,250,000*l.* That the total value of the manufacture cannot exceed this sum will appear highly probable from the exports. The average value of woollen goods exported from Great Britain at the close of the last century was 5,647,928*l.*

Most of the Custom House values of goods exported are greatly below their present value, but not so much so in this article as in some others; they are found, however, to be about thirty-eight per cent. below the actual value and this addition being made to the average amount, the value of woollen goods exported will appear to be 7,794,140*l.*

The value retained for home consumption may be nearly equal to the value exported, although in quantity the former may greatly exceed the latter, a very considerable proportion of which consists of superfine and second cloths, whereas the consumption of fine woollens in Great Britain has much diminished of late years, from the general use of Manchester manufactures of cotton in clothing, particular for waistcoats and breeches. The whole value of the manufacture thus appears to be about 15,588,000*l.* and, as a medium between this sum and the amount before stated, it may be taken at 16,400,000*l.* Deducting from this amount at the rate of ten per cent. on the cost of the goods for the profits of the manufacturer, including the interest of his capital, there remains 14,909,090*l.* consisting of the cost of the material, and the wages of labour; the value of all the wool employed, we have seen, is about 5,750,000*l.* and including the cost of some other necessary articles, the materials cannot be valued at less than this sum; the remainder therefore, or 9,159,090*l.* is the amount of workmanship, or the wages of all the persons employed in the manufacture.

It is scarcely possible to assume with precision an average rate of wages, with respect to any manufacture, as they vary in different parts of the country, and the proportion of the different classes of persons employed is in no instance known with certainty. In the West, where the woollen-manufacture has been for some

time past in a very depressed state, few workmen get above 14*s*. per week, and many much less from not being fully employed; in Yorkshire good workmen earn from 16*s*. to 18*s*. per week, children 3*s*. older children and women from 5*s*. to 6*s*. and old men from 9*s*. to 12*s*. If, on taking all classes together, 8*s*. per week is not thought too high, it will appear that the whole number of persons employed does not exceed 440,340. The value of the leather-manufacture was some years ago, stated at 10,500,000*l*. and from the state of the trade of late, particularly those branches of it which supply military accoutrements, harness, sadlery, carriages, &c. combined with the high price of skins of most kinds, it cannot be supposed less than that sum at present. Deducting 954,545*l*. for the profits of capital employed, and 3,500,000*l*. for the cost of the raw article, there remains 6,045,455*l*. for the wages of persons employed therein, which, at 25*l*. per annum for each person, makes the number employed 241,818. The cotton-manufacture was formerly of little importance in this country, in comparison with its present state. The total quantity of cotton-wool imported into England, on an average of five years, ending with 1705, was 1,170,881 pounds, and even so late as the year 1781, it amounted to only 5,101,920 pounds. About that time, however, the British calicoes, which had been introduced a few years before, had arrived at some degree of perfection, and the branch of muslins being added, in which great improvements were soon after made, the whole manufacture experienced such a rapid and great increase, that previously to the commencement of the war with France, the consumption of cotton-wool amounted to upwards of 30,000,000 pounds, per annum. The average value at the time referred to was 35,549,200 pounds, the value of which, when manufactured, cannot be less than 11,000,000*l*. allowing for a considerable quantity exported in a partially manufactured state. The total quantity of British calicoes and muslins printed in England, and Wales in the year 1800 was 28,692,790 yards, and in Scotland 4,176,939 yards, the duty on the whole amounting to 479,350*l*. 4*s*. 3¼*d*. Upon the supposition that the duty is one-tenth of the value, the value of this description of goods printed in 1800, will be 4,793,502*l*. The quantity of white calicoes and muslins made in Great Britain, is probably much greater than that of the printed; and though they do not incur the expence of printing and duty, yet as a greater proportion of them are fine goods, the value of them is probably rather above 3,500,000*l*.

There are many other branches of manufacture which consume large quantities of cotton, though it is difficult to form an idea of the precise amount; thus the hosiery branch was stated some years ago to employ 1,500,000 pounds, and it has certainly since increased considerably; the same quantity was said to be required for candle-wicks; and it will probably be a very moderate estimate to value all the cotton that is manufactured in any other way than in muslins and calicoes at 2,800,000*l*. The total value of the manufacture will thus appear to be, as before stated, about 11,000,000*l*. Deducting from this sum, 1,000,000*l*. for profits of a capital at ten per cent. and 4,443,650*l* for cost of the raw material at 2*s*. 6*d*. per pound, there remains 5,556,350*l*. for wages, which, if divided at the rate of only 16*l*. per annum for each person, on account of the large proportion of women and children employed, makes the whole number 347,271 persons. The silk-manufacture was formerly of greater extent than at present, but has not experienced any very considerable fluctuation for some time; the average quantity of raw and thrown silk imported in three years preceding the 5th January 1797, was 883,438*l*.; the value of which when manufactured is about 2,700,000*l*. The cost of silk to the manufacturer, if raw and thrown are taken together at only 28*s*. per pound, amounts to 1,260,000*l*. and the profits of the manufacture 245,454*l*. at the rate of ten per cent. on the cost when manufactured.

It may be said that though this is the usual profit charged by the manufacturer in this and some other branches, in casting up the selling price of his goods, they are freqnently sold much under this price; which must be admitted: but, as an advantage is taken on most of the component parts of the price before the ten per cent. is laid on, it is probably not less than this rate on the whole, in this and in most other manufactures. The number of persons employed in the silk-manufactory has been stated at 200,000 and upwards, but there appears no reason to believe that it exceeds 65,000 of all descriptions.

The linen manufacture of Great Britain is chiefly confined to Scotland, though some branches of it are carried on in Manchester

and other parts of England. The value estimated at the current prices, of linens exported, on an average of three years preceding 5th of January 1799, was 1,278,734*l.* therefore, if the quantity retained for home consumption is not greater than the export, the value of the whole must be upwards of 2,500,000*l.*; and it probably will not exceed the truth if the yearly value of the whole of this manufacture in Great Britain, with the thread, and other branches of the flax trade, is stated at 3,000,000*l.* The linens which most of the families in Scotland make for their own use are not stamped, and consequently are not included in these returns, which must therefore be less than the quantity actually manufactured by several millions of yards; and the value stated is certainly much below the actual selling prices. There is no account kept of the linen-manufacture in England; and as it is considered as an object of subordinate importance, its annual value is probably under 1,000,000*l.* but even if it is somewhat less than this amount, it will appear that the total value of the manufacture, rated at the current prices, cannot be less than the sum before stated, or 3,000,000*l.* The number of persons employed in it is probably not less than 95,000.

The hemp-manufacture at present exceeds 1,600,000*l.* per annum, but is less in time of peace; the persons employed in it are probably about 35,000.

The paper-manufacture has been greatly advanced of late. A hundred years ago scarcely any paper was made in this country but the coarse wrapping papers; and for a long time most of the superior kinds continued to be imported; the export is, however, at present considerable. The annual value of the manufacture, at the present high prices of the article, cannot be less than 900,000*l.* and the number of persons employed in it 30,000.

The glass-manufacture was much improved in the course of the last century, particularly in the article of plate-glass, and it has greatly increased of late years; it may now amount to 1,500,000*l.* per annum, and the persons employed in it to about 36,000.

The potteries, and manufactures of earthenware and porcelain, advanced rapidly during the last century, in consequence of the great improvements made in them, and the introduction of many new and beautiful wares, both for our own use and foreign markets. The article of queen's-ware was invented in 1763, by Mr. J. Wedgewood, to whom the public are also indebted for most of those elegant species of earthenware and porcelain which, moulded into a thousand different forms for ornament or use, now constitute the most valuable part of this manufacture. The annual value will probably not be over-rated at 2,000,000*l.* and the number of persons employed at 45,000.

The iron-manufacture is supplied partly by the produce of our own mines, and partly by those of other countries; with respect to the first, it appears that the total produce of pig-iron in Britain is at least 100,000 tons; and reckoning on an average, that 33 cwt. of crude iron produce one ton of bars, and that the manufacture of malleable iron amounts to 35,000 tons per annum, this branch will require 57,750 tons of crude iron; and the value in bars, at 20*l.* a ton, which is considerably under the present price, is 700,000*l.* the remaining 42,250 tons, cast into cannon, cylinders, and machinery, &c. at 14*l.* a ton, are worth 591,500*l.* The supply of foreign bar-iron is chiefly obtained from Russia and Sweden; and the quantity imported on an average of six years, ending with 1805, after deducting what was re-exported, has been 33,628 tons, value 865,182*l.* which, with the sums before mentioned, amount to 2,156,682*l.* This value is greatly increased by subsequent labour; but the proportion of the increase cannot be easily determined, the quantity of labour being so very different in different articles. Some years ago the value of the iron-manufacture was estimated at 8,700,000*l.* which sum appears rather too high at present; but including tin and lead, the value of the whole will probably not be taken too high at 10,000,000*l.* and the number of persons employed at 200,000.

The copper and brass manufactures are now established in this country in all their branches. Till about the years 1720 or 1730, most of the copper and brass utensils for culinary and other purposes, used in this country, were imported from Hamburgh and Holland, being procured from the manufactories of Germany; even so late as the years 1745 and 1750, copper tea-kettles, saucepans, and pots of all sizes, were imported here in large quantities; but through the persevering industry, capitals, and enterprising spirit of our miners and manufacturers, these imports have be-

come totally unnecessary, the articles being now all made here, and far better than any other country can produce. The discovery of new copper-mines in Cornwall, Derbyshire, and Wales, about the year 1773, contributed to the extension of the manufacture in this country; and it appears to be still increasing, notwithstanding the very great advance in the price of copper, which must certainly be attended with some disadvantage with respect to foreign markets. The value of wrought copper and brass exported during the year 1799 was 1,222,187*l.* and there is reason to believe, that the whole value of these manufactures at present is at least 3,600,000*l.* and the number of persons employed about 60,000. The steel, plating, and hardware manufactures, including the toy trade, have been carried to a great extent of late years, and may amount in value to 4,000,000*l.* and the persons employed to at least 70,000.

MANULEA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Pediculares, Jussieu. Essential character: calyx five-parted; corolla with a five-parted, awl-shaped border, the four upper segments more connected; capsule two-celled, many-seeded. There are eighteen species, mostly natives of the Cape of Good Hope.

MANURE. See AGRICULTURE.

MAP, a plane figure representing the surface of the earth, or some part of it; being a projection of the globular surface of the earth, exhibiting countries, seas, rivers, mountains, cities, &c. in their due positions, or nearly so.

Maps are either universal, or particular. Universal maps are such as exhibit the whole surface of the earth, or the two hemispheres. Particular, or partial maps, are those that exhibit some particular region, or part of the earth. Both kinds are usually called geographical, or land maps, as distinguished from hydrographical, or sea maps, which represent only the seas and sea-coasts, and are properly called charts.

Anaximander, it is said, about 400 years before Christ, first invented geographical tables, or maps. The Pentingerian tables, published by Cornelius Pentinger of Auesburgh, contain an itinerary of the whole Roman Empire; all places, except seas, woods, and deserts, being laid down according to their measured distances, but without any mention of latitude, longitude, or bearing.

The maps published by Ptolemy of Alexandria, A. D. 144, have meridians and parallels, the better to define and determine the situation of places, and are great improvements on the construction of maps: though Ptolemy himself owns that his maps were copied from some that were made by Marinus, Tirus, &c. with the addition of improvements of his own. But from his time till about the 14th century, during which geography and most sciences were neglected, no new maps were published. Mercator was the first of note among the moderns, and next to him Ortelius, who undertook to make a new set of maps, with the modern divisions of countries and names of places; for want of which, those of Ptolemy were become almost useless. After Mercator, many others published maps, but for the most part they were mere copies of his. Towards the middle of the 17th century, Bleau in Holland, and Sanson in France, published new sets of maps, with many improvements from the travellers of those times, which were afterwards copied, with little variation, by the English, French, and Dutch; the best of these being those of Vischer and De Witt. And later observations have furnished us with still more accurate and copious sets of maps.

Maps are constructed by making a projection of the globe, either on the plane of some particular circle, or by the eye placed in some particular point, according to the rules of perspective.

In maps three things are required: first, to shew the latitude and longitude of places, which is done by drawing a certain number of meridians and parallels of latitude. Secondly, the shape of the countries must be exhibited as accurately as possible, for real accuracy cannot be obtained by any projection, because the map is on a plane surface, whereas the earth is globular. Thirdly, the bearings of places, and their distances from each other must be shown. The projection of maps is made, as we have observed, according to the rules of perspective. If the eye be supposed to view the earth from an infinite distance, the appearance represented on a plane, is called the orthographic projection. In this case, the parts about the middle are very well represented, but the extreme parts are contracted. Geographers usually employ the stereographic projection, where the eye is supposed to be on the surface of the earth, and looking at the opposite hemisphere. There is

likewise the globular projection, in which meridians, equidistant upon the surface of the earth, are represented by equidistant circles in the map. Mercator's projection is that in which both the meridians and parallels of latitude are represented by straight lines. See CHART.

In all maps the upper part is the north, the lower the south, the right hand is eastern, and the left hand western. On the right and left the degrees of latitude are marked; and on the top and bottom the degrees of longitude are marked. When the meridians and parallels of latitude are straight, and parallel lines, the latitude of a place is found by stretching a thread over the place, so that it may cut the same degree of latitude on both sides the map, and that degree is the latitude of the place. To find the longitude, stretch a thread over the place, so that it may cut the same degree of longitude on the top and bottom, and that degree is the longitude of the place. When the meridians and parallels of latitude are curve lines, then to find the latitude of a place, a parallel line of latitude must be drawn through it, by the same rules as the other parallels are drawn, and it cuts the sides at the degree of latitude of the place: and to find the longitude of the place draw a circle of longitude through it, by the same rules as the other circles are drawn, and it cuts the top and bottom at the degree of longitude of the place. We shall now proceed to shew some of the most familiar constructions of maps, beginning with a general map, or map of the world, of which there are three methods:

First. A map of the world must represent two hemispheres; and they must both be drawn upon the plane of that circle which divides the two hemispheres. The first way is to project each hemisphere upon the plane of some particular circle, by the rules of orthographic projection, forming two hemispheres, upon one common base, or circle. When the plane of projection is that of a meridian, the maps will be the east and west hemispheres, the other meridians will be ellipses, and the parallel circles will be right lines. Upon the plane of the equinoctial, the meridians will be right lines crossing in the centre, which will represent the pole, and the parallels of latitude will be circles having that common centre, and the maps will be the northern and southern hemispheres. The fault of this way of drawing maps is, that near the outside the circles are too near one another; and, therefore, equal spaces on the earth are represented by very unequal spaces upon the map.

Secondly. Another way is to project the same hemispheres by the rules of stereographic projection; in which way, all the parallels will be represented by circles, and the meridians by circles or right lines. And here the contrary fault happens, *viz.* the circles towards the outsides are too far asunder, and about the middle they are too near together.

Thirdly. To remedy the faults of the two former methods, proceed as follows: 1st. for the eastern and western hemispheres, describe the circle P E N Q for the meridian (Plate Maps, fig. 1.) or plane of projection; through the centre of which draw the equinoctial, E Q, and axis, P N, perpendicular to it, making P and N the north and south pole. Divide the quadrants P E, E N, N Q, and Q P, into 9 equal parts, each representing 10 degrees, beginning at the equinoctial E Q: divide also C P and C N into 9 equal parts, beginning at E Q; and through the corresponding points draw the parallels of latitude. Again, divide C E and C Q into 9 equal parts; and through the points of division, and the two poles P and N, draw circles, or rather ellipses, for the meridians. So shall the map be prepared to receive the several places and countries of the earth. 2ndly. For the north or south hemisphere, draw A Q B E, for the equinoctial (fig. 2), dividing it into the four quadrants E A, A Q, Q B, and B E; and each quadrant into 9 equal parts, representing each 10 degrees of longitude; and then, from the points of division, draw lines to the centre, C, for the circles of longitude. Divide any circle of longitude, as the first meridian, E C, into 9 equal parts, and through these points describe circles from the centre, C, for the parallels of latitude; numbering them as in the figure.

In this third method equal spaces on the earth are represented by equal spaces on the map, as near as any projection will bear; for a spherical surface can no way be represented exactly upon a plane. Then the several countries of the world, seas, islands, sea-coasts, towns, &c. are to be entered in the map, according to their latitudes and longitudes.

In filling up the map, all places representing land are filled with such things as the countries contain; but the seas are left white; the shores adjoining to the sea being shaded. Rivers are marked by strong lines, or by double lines, drawn winding in form

of the rivers they represent; and small rivers are expressed by small lines. Different countries are best distinguished by different colours, or at least the borders of them. Forests are represented by trees; and mountains shaded to make them appear. Sands are denoted by small points or specks; and rocks under water by a small cross. In any void space, draw the mariner's compass, with the 32 points or winds.

To draw a Map of any particular Country. First. For this purpose its extent must be known, as to latitude and longitude; as suppose Spain, lying between the north latitudes 36 and 44, and extending from 10 to 23 degrees of longitude; so that its extent from north to south is 8 degrees, and from east to west 13 degrees. Draw the line A B for a meridian passing through the middle of the country (fig. 3.), on which set off 8 degrees from B to A, taken from any convenient scale; A being the north, and B the south point. Through A and B draw the perpendiculars C D, E F, for the extreme parallels of latitude. Divide A B into 8 parts, or degrees, through which draw the other parallels of latitude, parallel to the former. For the meridians, divide any degree in A B into 60 equal parts, or geographical miles. Then, since the length of a degree in each parallel decreases towards the pole, from the table, Art. LONGITUDE, shewing this decrease, take the number of miles answering to the latitude of B, which is 48½ nearly, and set it from B, 7 times to E, and 6 times to F; so is E F divided into degrees. Again, from the same table take the number of miles of a degree in the latitude A, viz. 43¼ nearly; which set off, from A, 7 times to C, and 6 times to D. Then from the points of division in the line C D, to the corresponding points in the line E F, draw so many right lines for the meridians. Number the degrees of latitude up both sides of the map, and the degrees of longitude on the top and bottom. Also, in some vacant place, make a scale of miles, or of degrees, if the map represent a large part of the earth, to serve for finding the distances of places upon the map.

Then make the proper divisions and subdivisions of the country: and having the latitudes and longitudes of the principal places, it will be easy to set them down in the map; for any town, &c. must be placed where the circles of its latitude and longitude intersect. For instance, Gibraltar, whose latitude is 36° 11′, and longitude 12° 27′, will be at G: and Madrid, whose latitude is 40° 10′, and longitude 14° 44′, will be at M. In like manner, the mouth of a river must be set down; but to describe the whole river, the latitude and longitude of every turning must be marked down, and the towns and bridges by which it passes. And so for woods, forests, mountains, lakes, castles, &c. The boundaries will be described by setting down the remarkable places on the sea coast, and drawing a continued line through them all. And this way is very proper for small countries.

Secondly. Maps of particular places are but portions of the globe, and therefore may be drawn after the same manner as the whole is drawn. That is, such a map may be drawn either by the orthographic or stereographic projection of the sphere, as in the last problem. But in partial maps, an easier way is as follows: having drawn the meridian A B (fig. 3.), and divided it into equal parts as in the last method, through all the points of division draw lines perpendicular to A B, for the parallels of latitude; C D, E F, being the extreme parallel. Then to divide these, set off the degrees in each parallel, diminished after the manner directed for the two extreme parallels C D, E F, in the last method: and through all the corresponding points draw the meridians, which will be curve lines; which were right lines in the last method; because only the extreme parallels were divided by the table. This method is proper for a large tract, as Europe, &c.; in which case the parallels and meridians need only be drawn to every 5 or 10 degrees. This method is much used in drawing maps, as all the parts are nearly of their due magnitude, but a little distorted towards the outside, from the oblique intersections of the meridians and parallels.

Thirdly. Draw P B of a convenient length, for a meridian; divide it into 9 equal parts, and through the points of division, describe as many circles for the parallels of latitude, from the centre P, which represents the pole. Suppose A B (fig. 4.) the height of the map, then C D will be the parallel passing through the greatest latitude, and E F will represent the equator. Divide the equator E F into equal parts, of the same size as those in A B, both ways, beginning at B. Divide also all the parallels into the same number of equal parts, but lesser in proportion to the numbers for the several latitudes, as directed in the last method for the rectilineal parallels. Then

through all the corresponding divisions draw curve lines, which will represent the meridians, the extreme ones being EC and FD. Lastly, number the degrees of latitude and longitude, and place a scale of equal parts, either of miles or degrees, for measuring distances. This is a very good way of drawing large maps, and is called the globular projection; all the parts of the earth being represented nearly of their due magnitude, excepting that they are a little distorted on the outsides.

Finally. To draw a map of Europe, which extends from 36° to 72° north latitude: draw a base line (fig. 5.) G H, in the middle of which erect a perpendicular, I P, and assume any distance for 10° of latitude. Let the point I be 30°, from which set off six of the assumed distances to P, which will be the north pole. Number the distances 40, 50, 60, &c. and on the centre, P, describe arcs passing through the points of divisions on the line I P, which will be parallels of latitude. Divide the space assumed for 10° of latitude into 60 parts, by some diagonal scale. Look into the table, Art. LONGITUDE, for the number of miles answering to 30°, which is 51.96; take this from the scale, and set it off on the arc 30° from the centre line both ways. Do the same for 40°, 50°, 60°, &c, and through the corresponding divisions on all the arcs draw curve lines; which will represent the meridian. When the degrees of latitude and longitude are marked the thing is done.

When the place is but small that a map is to be made of, as if a country were to be exhibited; the meridians, as to sense, will be parallel to one another, and the whole will differ very little from a plane. Such a map will be made more easily than by the preceding rules. It will here be sufficient to measure the distances of places in miles, and so lay them down in a plane rectangular map.

MAPLE, in botany, is of the genus ACER, which see. Of the several species the most important is the A. saccharinum, or American sugar maple, from which the Americans derive sugar in large quantities, by tapping the trees early in the spring, and boiling the juice. For this purpose large tracts of land in North America are devoted to the culture of this tree, which yields a sugar equal to the best cane, and which requires no other labour than what women and girls can bestow, in drawing off and boiling the liquor; and when skilfully tapped, the tree will last many years. A tree of an ordinary size yields in a good season from twenty to thirty gallons of sap, from which may be made from five to six pounds of sugar. The tree is tapped with an augur, first on the south side and then on the north, and the sap will flow five or six weeks according to the temperature of the weather. The sugar is manufactured much in the same manner as the cane sugar of the West Indies. In New York and Pensylvania many hundred private families have long supplied themselves plentifully with this sugar at little expense. One instance is mentioned of a family, consisting of a father and his two sons, who made nearly eighteen hundred weight in a single season. Dr. Rush, who attended very closely to this subject, supposes that four men, provided with proper conveniences, may make in a common season, of from four to six weeks, 40 cwt. of excellent sugar. The Indians of Canada are said to have practised the making of sugar for centuries; and Europeans, both French and English, have been in the habit of refining it for 140 years. See SUGAR.

MAPPIA, in botany, so called from Marcus Mappus, professor of medicine at Strasburg, a genus of the Polyandria Monogynia class and order. Essential character: calyx five-parted; corolla five-petalled; germ superior; berry one-seeded, seeds arilled. There is but one species, *viz.* M. guianensis, a shrub, found on the banks of the river Sinemari in Guiana.

MARALDI (JAMES PHILIP), in biography, a learned mathematician, astronomer, and natural philosopher, was born in the year 1665, at Perinaldo in the county of Nice, which had been already honoured by the birth of his maternal uncle, the celebrated Cassini. We are not informed where he received his education; but we are told that after he had for some time successfully cultivated literature, the bent of his genius led him to study the sublimer sciences, and particularly the mathematics. Having made a considerable progress, when he was twenty-two years of age, his uncle sent for him to Paris, where he had been settled a long time, that he might himself superintend his studies, and have the satisfaction of witnessing the efforts of his genius in a country where useful and extraordinary talents, both in natives and foreigners, were at that time much cherished and encouraged. Under such a tutor Maraldi made a wonderful proficiency, and soon answered the most flattering expectations which he had formed of him. To his uncle he implicitly

resigned the direction of his studies and his manners, and conceived for him the affection of a son, which met with an equal return. When Cassini found that his nephew's advancement in science, his extraordinary diligence, and his accuracy, had qualified him to become an useful assistant in his astronomical labours, by the direction of the Royal Academy of Sciences, he associated him with himself in making observations on the celestial bodies. A wide field was now opened for the industry and ingenuity of our young astronomer. In making his observations on the planets, he found that Kepler and Bouillaud had incorrectly determined the place of the aphelion of Jupiter. Comparing afterwards his observations with those of the Chaldean astronomers, made in the third century before the Christian era, he found that the nodes of that planet had retrograded more than fourteen degrees, and that owing to their natural motion; and he observed and accounted for other phenomena in the appearance of that planet and its satellites. After an assiduous attention to Mars, he acknowledged that Kepler's theory of that planet was so perfect, that scarcely any thing could be added to it. He corrected, however, some trifling inaccuracies; and he found that the parallax of the planet was less by one second, than had been determined by Cassini in 1672. During almost the whole of the year 1714, his observations were occupied by Saturn; and he shewed how the disappearance of his ring at that time confirmed the theory of Huygens. He also bestowed incredible industry in perfecting the tables of Jupiter's satellites. The results of his numerous observations he communicated to the Academy of Sciences, to whom they afforded the greatest satisfaction, and particularly his discovery that the eclipses of the satellites were of different durations, even when the distance of their nodes was the same. He was now justly considered as entitled to rank with the most skilful astronomers.

When Maraldi first applied himself to the contemplation of the heavens, he conceived the design of forming a catalogue of the fixed stars, more perfect and comprehensive than that of Bayer, an object of the greatest utility, and of the first importance in astronomy. For they are considered as so many fixed points, to which the motions of the comets, and of the other planets that are under them, are referred. Hence will appear the importance of an intimate acquaintance with them; the attainment of which is an object of no less difficulty than it is of moment. However, this difficulty did not deter Maraldi, who to the great injury of his health, applied himself to observe them with the most constant attention, at all seasons of the year. By this means he became so intimate with the fixed stars, that on being shown any one of them, however small, he could immediately tell to what constellation it belonged, and its place in that constellation. He has been known to discover those small comets which astronomers often take for the stars of the constellation in which they are seen, for want of knowing precisely of what stars the constellation consists, when others, on the same spot, and with eyes directed equally to the same part of the heavens, could not for a long time see any thing of them. Whenever Maraldi found it necessary to relax in his astronomical labours, by way of amusement he applied to the study of natural history, making observations on insects, curious petrifactions, &c. To the subject of bees he paid particular attention, not only acquainting himself with what ancient and modern writers have said concerning them, but providing himself with glass hives, that he might observe their labours and economy. On these and other subjects in natural history, he drew up a number of very interesting papers, which were received with great applause by the Academy of Sciences, and are inserted in different volumes of their memoirs. In the year 1699, Maraldi was admitted a member of that body. In 1700, he was employed under Cassini in prolonging the French meridian to the northern extremity of France, and had no small share in completing it. When this business was finished, he paid a visit to Italy, where the astronomers every where gladly availed themselves of his advice and assistance in making their observations; and Eustachio Manfredi has made due acknowledgments of his great obligations to him. Being come to Rome, on the invitation of Pope Clement XI. he assisted at the assemblies of the congregation then sitting in that city for the purpose of reforming the calendar. Bianchini also availed himself of his advice and aid, in constructing the great meridian line at the baths of Dioclesian. While he continued at Rome, he had an opportunity of observing an eclipse of the fourth satellite of Jupiter, in the upper part of his circle, from which he was led to the conclusion, that its inclination is three minutes less than as fixed by

Cassini. In 1703, Maraldi returned to France, with a rich treasure of subjects in natural history, chiefly collected at Verona, which he presented to the Academy of Sciences. In the year 1718, he was employed, with three other academicians, in prolonging the French meridian to the southern extremity of that kingdom. Still, however, the greatest part of his time was occupied within the walls of the observatory of Paris, where he was incessantly employed in observing every thing that was curious and useful in the motions and phenomena of the heavenly bodies, in ingenious applications of the methods laid down by Cassini, in verifying theories with which it is of consequence to be acquainted, in correcting other theories which are susceptible of improvement, and in completing his catalogue. This last mentioned great work he did not live entirely to finish; for just after he had placed a mural quadrant on the terrace of the observatory, in order to observe some stars towards the north and the zenith, he fell sick of a fever, and died in December 1729, in the sixty-fifth year of his age. He is highly commended for seriousness, integrity, sincerity, a generous spirit, the purest morals, and an interesting simplicity of manners. He was not proud of the rank which he held in the scientific world, and was never more gratified than when he could render service to others, by communicating to them freely the discoveries and improvements which he had made, at the expense of inconceivable labour and application. He did not publish his catalogue, or any other of his productions, but communicated an immense number of papers to the Royal Academy of Sciences, which are inserted in their "Memoirs" for almost every year from 1699 to 1729, and not uncommonly several papers in the same year.

MARANTA, in botany, *Indian arrow-root*, a genus of the Monandria Monogynia class and order. Natural order of Scitamineæ. Cannæ, Jussieu. Essential character: calyx three-leaved; corolla trifid; nectary three-parted, the third part bearing the anther on its upper side. There are five species, of which M. arundinacea, Indian arrow-root, has a thick, fleshy, creeping root, full of knots, from which arise many smooth leaves, six or seven inches long, and three broad towards their base; the stalks about two feet high, the ends of which are terminated by a loose bunch of small white flowers, standing upon peduncles two inches long; the flowers are cut into six narrow segments, indented on their edges; these sit upon the embryo, which afterwards turns to a roundish three-cornered capsule, inclosing one hard rough seed. It is called Indian arrow-root, because it was thought to extract the poison from wounds inflicted by the poisoned arrows of the Indians. The root washed, pounded fine, and bleached, makes a powder and starch; it is recommended as a proper food for infants, and is gelatinous like salep. It is a native of South America, and is cultivated in the West Indies; it is found in great plenty near La Vera Cruz.

MARATTIA, in botany, so named in honour of Giovanni Francesco Maratti, an Italian botanist, a genus of the Cryptogamia Filices class and order. Natural order of Filices or Ferns. Essential character; capsules oval, gaping longitudinally at top, with several cells on each side. There are three species.

MARBLE is a kind of stone, found in great masses, and dug out of pits or quarries. It is of so hard, compact, and fine a texture as readily to take a beautiful polish, and much used in ornaments of buildings, as columns, statues, altars, tombs, chimney-pieces, tables, and the like. There are infinite numbers of different kinds of marble. Some are of one simple colour, as white or black; others variegated with stains, clouds, waves, and veins: but all opaque, excepting the white, which, cut into thin pieces, becomes transparent. Marble is found in considerable quantities, in most of the mountainous parts of Europe. Derbyshire is that county of England most abounding in this article. Near Kemlyn Bay, in the island of Anglesea, there is a quarry of beautiful marble, called Verde di Corsica, being common to this place, some parts of Italy, and Corsica. Its colours are green, black, white, and dull purple, irregularly disposed. Italy is that part of Europe which produces the most valuable marble, and in which its exportation makes a considerable branch of foreign commerce. The black and the milk-white marble, coming from Carara, a town in the duchy of Massa, are particularly esteemed.

MARBLES, *Arundel*, ancient marbles with a chronicle of the city of Athens inscribed on them, many years before our Saviour's birth; presented to the University of Oxford by Thomas Earl of Arundel, whence the name. See ARUNDELIAN.

MARBLING, in general, the painting

any thing with veins and clouds, so as to represent those of marble.

Marbling of books or paper is performed thus: dissolve four ounces of gum arabic into two quarts of fair water; then provide several colours mixed with water in pots or shells, and with pencils peculiar to each colour, sprinkle them by way of intermixture upon the gum water, which must be put into a trough, or some broad vessel; then with a stick curl them, or draw them out in streaks, to as much variety as may be done. Having done this, hold your book, or books, close together, and only dip the edges in, on the top of the water and colours, very lightly; which done, take them off, and the plain impression of the colours in mixture will be upon the leaves; doing as well the ends as the front of the book in the like manner, and afterwards glazing the colours.

MARCGRAVIA, in botany, so called from George Marcgraaf, of Leibstadt, a genus of the Polyandria Monogynia class and order. Natural order of Putamineæ. Capparides, Jussieu. Essential character: corolla one-petalled, calyptre-shaped; calyx six-leaved, imbricate; berry many-celled, many-seeded. There is but one species, *viz.* M. umbellata, which is a native of the West Indies, in the cool woody mountains. Brown says, it is frequent in the woods of Jamaica, appearing in such various forms that it has been mistaken for different plants in the different stages of its growth.

MARCHANTIA, in botany, so named in honour of Nicholas Marchant, M. D. a genus of the Cryptogamia Hepaticæ, Jussieu. Essential character: male, calyx salver shaped; anthers numerous, imbedded in its disk; female, calyx peltate, flowering on the under side; capsules opening at top; seeds fixed to elastic fibres. Seven species are enumerated in the "Systema Vegetabilium;" of these five are natives of Britain. M. polymorpha is very common in wet places, on shady walks, and by the sides of wells and springs; in figure it resembles an oak leaf; the peduncles are in the angles of the lobes, from one to three inches high; capsules greenish, dividing into eight segments; on the upper surface are glass-shaped conical cups, on short pedicels, with a wide scalloped margin, inclosing four little bodies, very finely serrated at the edges.

MARE. See Equus.

MARGARITARIA, in botany, a genus of the Dioecia Octandria class and order. Essential character: male, calyx four-toothed; corolla four-petalled: female, calyx and corolla as in the male; styles four or five; berry cartilaginous, four or five grained. There is but one species, *viz.* M. nobilis, found in Surinam.

MARICA, in botany, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ. Irides, Jussieu. Essential character: corolla six-parted, with three alternate segments, as small again as the others; stigma petal-form trifid, with the three divisions simple, acute; capsule three-celled, inferior. There is but one species, *viz.* M. paludosa, a native of the moist meadows of Guiana.

MARILA, in botany, a genus of the Polyandria Monogynia class and order. Essential character: calyx five-leaved; corolla five-petalled; capsule four-celled, many-seeded; stigma simple. There is but one species, *viz.* M. racemosa, a native of the West Indies.

MARINE, a general name for the navy of a kingdom or state; as also the whole economy of naval affairs, or whatever respects the building, rigging, arming, equipping, navigating, and fighting ships. It comprehends likewise the government of naval armaments, and the state of all the persons employed therein, whether civil or military.

Marine *acid*. See Muriatic *acid*.

Marine-*chair*, a machine invented for viewing the satellites of Jupiter at sea, and thereby determining the longitude of their eclipses.

Marine *remains*, a term used to express the shells of sea-fishes, and parts of crustaceous and other sea-animals, found in digging at great depths in the earth, or on the tops of high mountains. Being found in these situations, is an evident and unquestionable proof of the sea having been once there, since it must have covered those places where it has left its productions. It has been the general opinion, that these marine bodies were carried to the places where they are occasionally found by the waters of the universal deluge, described in the Old Testament. There are, however, evident proofs that it cannot have been the cause of all that is attributed to it, and there must have been some other cause of many of these remains having been placed where we now find them.

Marine *surveyor*, is the name of a machine, contrived by Mr. H. de Saumarez, for measuring the way of a ship at sea. The machine is in the form of the letter Y, and is made of iron, or other metal. At

each end of the lines which constitute the angle or upper part of the letter, are two pallets, not much unlike the figure of the log; one of which falls in the same proportion as the other rises. The falling or pendant pallet meeting a resistance from the water, as the ship moves, has by that means a circular motion under water, which is faster or slower according as the vessel moves. This motion is communicated to a dial within the ship, by means of a rope fastened to the tail of the Y, and carried to the dial. The motion being thus communicated to the dial, which has a bell in it, it strikes exactly the number of paces, miles, &c. which the ship has run. Thus the ship's distance is ascertained, and the forces of tides and currents may also be discovered by this instrument. See Phil. Trans.

MARINER'S *compass*, is an instrument used at sea by mariners to direct and ascertain the course of their ships. It consists of a circular brass box, which contains a paper card with the 32 points of the compass or winds, fixed on a magnetic needle that always turns to the north, excepting a small deviation, which is variable at different places, and at the same place at different times. The needle, with the card, turns on an upright pin fixed in the centre of the box. To the middle of the needle is fixed a brass conical socket or cap, by which the card hanging on the pin turns freely round the centre. The top of the box is covered with a glass, to prevent the wind from disturbing the motion of the card. The whole is inclosed in another box of wood, where it is suspended by brass hoops or gimbals, to keep the card in a horizontal position during the motions of the ship. The whole is to be so placed in the ship, that the middle section of the box, parallel to its sides, may be parallel to the middle section of the ship along its keel. See Plate Miscel. fig. 9.

The mariner's compass was long very rude and imperfect, but at length received great improvement from the invention and experiments of Dr. Knight, who discovered the useful practice of making artificial magnets; and the farther emendations of Mr. Smeaton, and Mr. M'Culloch, by which the needles are larger and stronger than formerly, and instead of swinging in gimbals, the compass is supported in its very centre upon a prop, and the centres of motion, gravity, and magnetism are brought almost all to the same point. After the discovery of that most useful property of the magnet, or loadstone, *viz.* its giving a polarity to hardened iron or steel, the compass was many years in use before it was known in anywise to deviate from the poles of the world. About the middle of the sixteenth century, so confident were some persons that the needle invariably pointed due north, that they treated with contempt the notion of the variation, which about that time began to be suspected. However, careful observations soon discovered, that in England and its neighbourhood, the needle pointed to the eastward of the true north line; and the quantity of this deviation being known, mariners became as well satisfied as if the compass had none; because the true course could be obtained by making allowance for the true variation.

From succeeding observations it was afterwards found, that the deviation of the needle from the north was not a constant quantity, but that it gradually diminished, and at last, namely about the year 1657, it was found that the needle pointed due north at London, and has ever since been going to the westward.

The azimuth compass differs from the common sea compass in this; that the circumference of the card or box is divided into degrees; and there is fitted to the box an index with two sights, which are upright pieces of brass, placed diametrically opposite to each other, having a slit down the middle of them, through which the sun or star is to be viewed at the time of observation. See AZIMUTH.

The figure of the compass card, with the names of the 32 points or winds, are given Plate Miscel. fig. 10. As there are 32 whole points quite around the circle, which contains 360 degrees, therefore each point of the compass contains the thirty-second part of 360, that is, $11\frac{1}{4}$ degrees, or $11^\circ 15'$; consequently the half point is $5^\circ 37' 30''$, and the quarter point $2^\circ 48' 45''$.

The points of the compass are otherwise called rhumbs; and the numbers of degrees, minutes, and seconds, made by every quarter point with the meridian, are exhibited in the following table.

A TABLE

Of Rhumbs, shewing the Degrees, Minutes, and Seconds, that every Point and Quarter-point of the Compass makes with the Meridian.

North.		Pts. qr.	° ′ ″	Pts. qr.	South.	
		0 1	2 48 45	0 1		
		0 2	5 37 30	0 2		
		0 3	8 26 15	0 3		
N b E	N b W	1 0	11 15 0	1 0	S b E	S b W
		1 1	14 3 45	1 1		
		1 2	16 52 30	1 2		
		1 3	19 41 15	1 3		
N N E	N N W	2 0	22 30 0	2 0	S S E	S S W
		2 1	25 18 45	2 1		
		2 2	28 7 30	2 2		
		2 3	30 56 15	2 3		
N E b N	N W b N	3 0	33 45 0	3 0	S E b S	S W b S
		3 1	36 33 45	3 1		
		3 2	39 22 30	3 2		
		3 3	42 11 15	3 3		
N E	N W	4 0	45 0 0	4 0	S E	S W
		4 1	47 48 45	4 1		
		4 2	50 37 30	4 2		
		4 3	53 26 15	4 3		
N E b E	N W b W	5 0	56 15 0	5 0	S E b E	S W b W
		5 1	59 3 45	5 1		
		5 2	61 52 30	5 2		
		5 3	64 41 15	5 3		
N N E	W N W	6 0	67 30 0	6 0	E S E	W S W
		6 1	70 18 45	6 1		
		6 2	73 7 30	6 2		
		6 3	75 56 15	6 3		
E b N	W b N	7 0	78 45 0	7 0	E b S	W b S
		7 1	81 33 45	7 1		
		7 2	84 22 30	7 2		
		7 3	87 11 15	7 3		
East	West	8 0	90 0 0	8 0	East	West

MARINES, a body of soldiers raised for the sea service, and trained to fight either in a naval engagement or in an action at shore. The direction of this body is vested in the Lords Commissioners of the Admiralty. It is stationed in three divisions, one at Chatham, one at Portsmouth, and another at Plymouth.

MARITIME, something relating to, or bounded by the sea: thus, a maritime province, or country, is one bounded by the sea; and a maritime kingdom or state is one that makes a considerable figure, or is very powerful at sea. Hence, by maritime powers, among the European states, are understood Great Britain and Holland.

MARK, in commerce, a certain note which a merchant puts upon his goods, or upon the cask, hogshead, &c. that contains them, in order to distinguish them from others, such as a grape, a crow's foot, a diamond, a cross, an asterisk, &c. Some use one or other of these marks by themselves; others join them with the initial letters of their own name, and others use the letters only.

Mark, or Marc, also denotes a weight used in several states of Europe, and for several commodities, especially gold and silver. In France the mark is divided into eight ounces, or sixty-four drachms, or one hundred and ninety-two derniers or penny-weights, or one hundred and sixty esterlines, or three hundred mailles, or six hundred and forty felins, or four thousand six hundred and eight grains. In Holland the mark-weight is also called troy-weight, and is equal to that of France. When gold and silver are sold by the mark, it is divided into twenty-four caracts. See Caract.

Mark is also used among us for a money

of account, and in some other countries for a coin. The English mark is two thirds of a pound sterling, or thirteen shillings and four-pence, and the Scotch mark is of equal value in Scotch money of account. The mark-lubs, or Lubeck-mark, used at Hamburgh, is also a money of account, equal to one-third of the rix-dollar, or to the French livre: each mark is divided into sixteen sols-lubs. Mark-lubs is also a Danish coin equal to sixteen sols-lubs. Mark is also a copper and silver coin in Sweden.

MARKET, the establishment of public marts or places of buying and selling, with the tolls belonging to it, is enumerated as one of the King's prerogatives, and markets can only be set up by virtue of the King's grant, or by immemorial usage.

All sales and contracts, of any thing saleable in markets overt, will not only be good as between the parties, but binding also upon all persons having any property therein.

In London, every shop in which goods are exposed publicly to sale, is market overt for such things only as the owner professes to trade in; though if the sale be in a warehouse, and not publicly in the shop, the property is not altered; but if goods are stolen from one, and sold out of the market overt, the property is not altered, and the owner may take them wherever he finds them. If a man buy his own goods in a market, the contract shall not bind him, unless the property had been previously altered by a former sale.

MARLE, in mineralogy, is divided into two sub-species, *viz.* the earthy marle, and the indurated marle: the former is of a yellowish grey colour, principally employed for improving bad land. It is found in Thuringia. The latter is grey; it occurs massive, the lustre is dull; it is opaque, soft so as to yield to the nail, easily frangible, and not very heavy; it melts before the blow-pipe into a blackish kind of glass; it effervesces with acids; it occurs in beds in the floetz lime-stone, and independent coal formations; in the first it alternates with beds of lime-stone, and sometimes occurs in nests of it. It is found in the coal works near Dresden, and is employed in improving bad land; as also mortar, and where lime-stone is not easily had, in the smelting of ores of iron. In the business of agriculture, marle is distinguished into the common, which includes the earthy marle, and some varieties of potters' clay; stone-marle, which is the earthy indurated: slate marle, which is the slaty indurated; shell-marle, which is either the earthy or indurated, abounding with shells. Mr. Jameson says, it passes into lime-stone and indurated clay, and according as alumina or silica preponderates, it receives the name of clay or lime marle.

MARQUE, or *Letters of Marque*, in military affairs, are letters of reprisal, granting the subjects of one prince or state liberty to make reprisals on those of another. Letters of marque among us, are extraordinary commissions granted by authority, for reparation to merchants, taken and despoiled by strangers at sea; and reprisals is only the retaking, or taking of one thing for another. In the prosecution of these letters there must be, 1. The oath of the person injured, or other sufficient proof, touching the injury sustained. 2. A proof of due prosecution for satisfaction in a legal way. 3. The deferring or denial of justice. 4. A complaint to his own prince or state. 5. A requisition of justice made to the supreme head of the state. After all which, letters of reprisal, under certain restrictions, are issued; but if the supreme power think these letters of reprisal may affect the peace of the state, they are put off till a more convenient time.

MARQUETRY, or INLAID *work*, is a curious work composed of several fine hard pieces of wood, of various colours, fastened in thin slices on a ground, and sometimes enriched with other matters, as silver, brass, tortoise-shell, and ivory; with these assistances the art is now capable of imitating any thing; whence it is by some called the art of painting in wood.

The ground on which the pieces are to be arranged and glued, is usually of well dried oak or deal, and is composed of several pieces glued together, to prevent its warping. The wood to be used in marquetry is reduced into leaves, of the thickness of a line, or the twelfth part of an inch, and is either of its natural colour, or stained, or made black to form the shades by other methods: this some perform by putting it in sand heated very hot over the fire: others by steeping it in lime water and sublimate; and others in oil of sulphur. The wood being of the proper colours, the contours of the pieces are formed according to the parts of the design they are to represent: this is the most difficult part of marquetry, and that which requires the most patience and attention.

The leaves to be formed, of which there are frequently three, four, or more joined together, are, after they have been glued on the outermost part of the design, whose profile they are to follow, put within the chaps of the vice; then the workman pressing the treddle, and thus holding fast the piece, with his saw runs over all the outlines of his design. By thus joining or forming three or four pieces together, not only time is saved, but also the matter is the better enabled to sustain the effort of the saw, which, how fine soever it may be, and how slightly soever it may be conducted by the workman, except this precaution were taken, would be apt to raise splinters, and ruin the beauty of the work. All the pieces having been thus formed by the saw, and marked, in order to their being known again, each is veneered, or fastened in its place, on the common ground, with the best English glue; and this being done, the whole is set in a press to dry, planed over, and polished with the skin of the sea-dog, wax, and shave-grass, as in simple veneering, and the fine branches and more delicate parts of the figures are touched up and finished with a graver.

MARQUIS, a title of honour, next in dignity to that of duke, first given to those who commanded the marches, that is, the borders and frontiers of countries. Marquisses were not known in England till King Richard II. in the year 1337, created his great favourite, Robert Vere, the Earl of Oxford, Marquis of Dublin; since which time there have been many creations of this sort, though at present there are twelve English, two Scotch, and nine Irish marquisses. The manner of creating a marquis differs in nothing from that of a duke, except the difference of the titles, and the marquis's being conducted by a marquis and an earl, while a duke is led by a duke and a marquis; he is also girt with a sword, has a gold verge put into his hand, and his robe or mantle is the same as those of a duke, with only this difference, that a duke's mantle has four guards of ermine, and a marquis's only three and a half. The title given him, in the style of the heralds, is most noble and potent prince. His cap is the same as a duke's, and the difference between their coronets consists in the duke's being adorned with only flowers or leaves, while the marquis's has flowers and pyramids with pearls on them intermixed, to show that he is a degree between a duke and an earl.

MARRIAGE is the lawful conjunction of man and wife; it was also anciently used to denote the interest of bestowing a ward or a widow in marriage.

Taking marriage in the light of a civil contract, the law treats it as it does all other contracts: allowing it to be good and valid in all cases where the parties, at the time of making it, were in the first place willing to contract; secondly, able to contract; and lastly, actually did contract, in the proper forms and solemnities required by law.

By several statutes, a penalty of 100*l.* is inflicted for marrying any persons without banns or licence; but by 26 George II. c. 33, if any person shall solemnize matrimony without banns or licence, obtained from some persons having authority to grant the same, or in any other place than a church or chapel where banns have been usually published, unless by special licence from the Archbishop of Canterbury, he shall be guilty of felony, and transported for fourteen years, and the marriage shall be void. Marriages according to the laws of any other country are valid in England, if duly solemnized in another country, as marriages in Scotland are; but by 26 George II. c. 33, s. 11, marriages by licence, where the parties are not twenty-one, must not be without consent of the father or guardian of the party. If the guardian or mother is beyond sea, or insane, the Chancellor will proceed upon relation in their stead. Questions have lately arisen, whether this act applies to illegitimate children, and the civilians have held that it does. Marriages cannot be solemnized between persons within the Levitical degrees, but if solemnized, they are not void till after sentence of the proper court. Promises of marriage, and pre-contracts, do not prevent the parties from lawfully marrying other persons; but an action lies for a breach of the contract. Marriage brokage bonds are void in equity, and all contracts in restraint of marriage generally are void; but contracts and legacies, upon condition not to marry any particular person, or without proper consent, are allowed, though if there is not a devise over the legacy is vested nevertheless. To marry a woman an heiress forcibly, is a capital felony by 3 Henry VII. c. 2, and 39 Elizabeth, c. 9.

A wife cannot leave her husband. If she elope from him, she loses her dower, unless she returns and is reconciled. An action of trespass lies for taking away a wife, with the goods of her husband, and

also for criminal conversation with the wife of any one.

If a man ill-use and turn his wife away, she has credit for necessaries wherever she goes, and he is obliged to pay her debts; but it is otherwise if she elopes or commits adultery. A married woman cannot be sued for her own debts, although she has a separate maintenance.

Divorces are of two kinds, absolute, and from bed and board. The former can only be by act of Parliament, unless it is for some original defect in the marriage; the latter is allowed on account of ill-treatment, &c., and then the wife has alimony or maintenance allowed her.

Marriage, in political economy. The reader may find many curious calculations and remarks relating to this subject in Dr. Price's "Observations on Reversionary Payments." From a variety of facts it appears, that marriages, one with another, do each produce about four births, both in England and other parts of Europe. Dr. Price observes, that the births at Paris are above four times the weddings; and therefore it may seem, that in the most healthy country situations, every wedding produces above four children; and though this be the case in Paris, for reasons which he has given, he has observed nothing like it in any other great town. He adds, that from comparing the births and weddings in countries and towns where registers of them have been kept, it appears, that in the former, marriages one with another seldom produce less than four children each; generally between four and five, and sometimes above five; but in towns seldom above four, generally between three and four, and sometimes under three. It is necessary to be observed here, that though the proportion of annual births to weddings has been considered as giving the true number of children derived from each marriage, taking all marriages one with another: yet this is only true, when, for many years, the births and burials have kept nearly equal. Where there is an excess of the births, occasioning an increase, the proportion of annual births to weddings must be less than the proportion of children derived from each marriage; and the contrary must take place where there is a decrease: and by Mr. King's computation, about one in a hundred and four persons marry; the number of people in England being estimated at five millions and a half, whereof about forty-one thousand annually marry. In the district of Vaud in Switzerland, the married are very nearly a third part of the inhabitants. Major Graunt and Mr. King disagree in the proportions between males and females, the latter making ten males to thirteen females in London; in other cities and towns, and in the villages and hamlets, one hundred males to ninety-nine females; but Major Graunt, both from the London and country bills, computes that there are in England fourteen males to thirteen females; whence he justly infers, that the Christian religion, prohibiting polygamy, is more agreeable to the law of nature than Mahometanism, and others that allow it. This proportion of males to females Mr. Derham thinks pretty just, being agreeable to what he had observed himself. In the hundred years, for instance, of his own parish register of Upminster, though the burials of males and females were nearly equal, being 633 males, and 623 females in all that time; yet there were baptized 709 males, and but 675 females, which is 13 females to 13.7 males. From a register kept at Northampton for 28 years, from 1741 to 1770, it appears that the proportion of males to females, that were born in that period, is 2,361 to 2,288, or nearly 13.4 to 13.

However, though more males are born than females, Dr. Price has sufficiently shown, that there is a considerable difference between the probabilities of life among males and females in favour of the latter; so that males are more short-lived than females; and as the greater mortality of males takes place among children, as well as among males at all ages, the fact cannot be accounted for merely by their being more subject to untimely deaths by various accidents, and by their being addicted to the excesses and irregularities which shorten life. M. Kerseboom informs us, that during the course of 125 years in Holland, females have in all accidents of age, lived about three or four years longer than the same number of males. In several towns of Germany, &c. it appears, that of 7,270 married persons who had died, the proportion of married men who died, to the married women, was three to two; and in Breslaw for eight years, as five to three. In all Pomerania, during nine years, from 1748 to 1756, this proportion was nearly 15 to 11. Among the ministers and professors in Scotland, 20 married men die to 12 married women, at a medium of 27 years, or in the proportion

of five to three; so that there is the chance of three to two, and in some circumstances even a greater chance, that the woman shall be the survivor of a marriage, and not the man; and this difference cannot be accounted for merely by the difference of age between husbands and their wives, without admitting the greater mortality of males. In the district of Vaud in Switzerland, it appears, that half the females do not die till the age of 46 and upwards, though half the males die under 36. It is likewise an indisputable fact, that in the beginning of life, the rate of mortality among males is much greater than among females. From a table formed by Dr. Price, from a register kept for 20 years at Gainsborough, it appears, that of those who lived to 80, the major part, in the proportion of 49 to 32, are females. M. Deparcieux at Paris, and M. Wargentin in Sweden, have further observed, that not only women live longer than men, but that married women live longer than single women. From some registers examined by M. Muret in Switzerland, it appears, that of equal numbers of single and married women, between 15 and 25, more of the former died than of the latter, in the proportion of two to one. With respect to the difference between the mortality of males and females, it is found to be much less in country parishes and villages than in towns; and hence it is inferred, that human life in males is more brittle than in females, only in consequence of adventitious causes, or of some particular debility that takes place in polished and luxurious societies, and especially in great towns. From the inequality above-stated, between the males and females that are born, it is reasonable to infer, that one man ought to have but one wife; and yet that every woman, without polygamy, may have a husband: this surplus of males above females being spent in the supplies of war, the seas, &c. from which the women are exempt. Perhaps, says Dr. Price, it might have been observed with more reason, that this provision had in view that particular weakness or delicacy in the constitution of males, which makes them more subject to mortality; and which consequently renders it necessary that more of them should be produced, in order to preserve in the world a due proportion between the two sexes. That this is a work of Providence, is well made out by the very laws of chance, by Dr. Arbuthnot, who supposes Thomas to lay against John, that for 82 years running more males shall be born than females; and giving all allowances in the computation to Thomas's side, he makes the odds against Thomas, that it does not so happen, to be near five millions of millions of millions of millions to one; but for ages of ages, according to the world's age, to be near an infinite number to one. According to M. Kerseboom's observations, there are about 325 children born from 100 marriages. M. Kerseboom, from his observations, estimates the duration of marriages, one with another, as in the following table. Those whose ages, taken together, make

40, live together between	24 and	25 years.
50	22	23
60	23	21
70	19	20
80	17	18
90	14	15
100	12	13

"Phil. Trans." No. 468.

Dr. Price has shown, that on De Moivre's hypothesis, or that the probabilities of life decrease uniformly, the duration of survivorship is equal to the duration of marriage, when the ages are equal; or, in other words, that the expectation of two joint lives, the ages being equal, is the same with the expectation of survivorship; and, consequently, the number of survivors, or (which is the same, supposing no second marriages) of widows and widowers, alive together, which will arise from any given set of such marriages constantly kept up, will be equal to the whole number of marriages, or half of them (the number of widows in particular) equal to half the number of marriages. Thus, the expectation of two joint lives, both 40, is the third of 46 years, or their complement, *i. e.* 15 years and four months; and this is also the expectation of the survivor. That is, supposing a set of marriages between persons all 40, they will, one with another, last just this time, and the survivors will last the same time. In adding together the years which any great number of such marriages, and their survivorships, have lasted, the sums would be found to be equal. It is observed further, that if the number expressing the expectation of single or joint lives, multiplied by the number of single or joint lives whose expectation it is, be added annually to a society or town, the sum gives the whole number living together, to which such an annual addition would in time

grow: thus, since 19, or the third of 57, is the expectation of two joint lives whose common age is 29, or common complement 57, 20 marriages every year between persons of this age would, in 57 years, grow to 20 times 19, or 380 marriages always existing together. The number of survivors also arising from these marriages, and always living together, would, in twice 57 years, increase to the same number. Moreover, the particular proportion that becomes extinct every year, out of the whole number constantly existing together of single or joint lives, must, wherever this number undergoes no variation, be exactly the same with the expectation of those lives at the time when their existence commenced. Thus, if it were found, that a nineteenth part of all the marriages among any body of men, whose numbers do not vary, are dissolved every year by the deaths of either the husband or wife, it would appear, that 19 was, at the time they were contracted, the expectation of these marriages.

Dr. Price observes, that the annual average of weddings among the ministers and professors in Scotland, for the last 27 years, has been 31; and the average of married persons, for 17 years ending in 1767, had been 667. This number, divided by 31, gives $21\frac{1}{2}$, the expectation of marriage among them; which, he says, is above two years and a half more than the expectation of marriage would be, by Dr. Halley's table, on the supposition that all first, second, and third marriages, may be justly considered as commencing, one with another, so early as the age of 30; and he has proved, that the expectation of two equal joint lives, is to the expectation of a single life of the same age, as two to three: consequently, the expectation of a single life at 30, among the ministers in Scotland, cannot be less than 32.25. If we suppose the mean ages of all who marry annually to be 33 and 25, the expectation of every marriage would be 19 years; or, one with another, they would be all extinct in 19 years: the marriages which continue beyond this term, though fewer in number, enjoying among them just as much more duration as those that fall short of it enjoy less. But it appears from the observations and tables of M. Muret, that, in the district of Vaud (dividing half the number of married persons, *viz.* 38,328, by the annual medium of weddings, *viz.* 808) the expectation of marriage is only $23\frac{1}{2}$ years: so much higher are the probabilities of life in the country than in towns, or than they ought to be, according to De Moivre's hypothesis. See PRICE'S ANNUITIES.

MARROW, in anatomy, a soft oleaginous substance contained in the cavity of the bones.

MARRUBIUM, in botany, *horehound*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: calyx salver shaped, rigid, ten-streaked; corolla upper lip bifid, linear, straight. There are eleven species. These plants are chiefly preserved in botanic gardens for the sake of variety.

MARS, in astronomy, the planet that revolves next beyond the earth in our system, is of a red fiery colour, and always gives a much duller light than Venus, though sometimes he equals her in size. He is not subject to the same limitation in his motions as Mercury or Venus, but appears sometimes very near the sun, and at others at a great distance from him; sometimes rising when the sun sets, or setting when he rises. Of this planet it is remarkable, that when he approaches any of the fixed stars, which all the planets frequently do, these stars change their colour, grow dim, and often become totally invisible, though at some little distance from the body of the planet; but Dr. Herschel thinks this has been exaggerated by former astronomers. Mars appears to move from west to east round the earth. The mean duration of his sidereal revolution is 686.979579 days. His motion is very unequal. When we first perceive this planet in the morning when he begins to separate from the sun, his motion is direct, and the most rapid possible. This rapidity diminishes gradually, and the motion ceases altogether, when the planet is about 137° distant from the sun; then his motion becomes retrograde, and increases in rapidity till he comes into opposition with the sun. It then gradually diminishes again, and becomes nothing when Mars approaches within 137° of the sun. Then the motion becomes direct, after having been retrograde for seventy-three days, during which interval the planet described an arc of about 16°. Continuing to approach the sun, the planet at last is lost in the evening rays of that luminary. All these different phenomena are renewed after every opposition of Mars, but there are considerable differences both in the extent and duration of his retrogradations.

Mars does not move in the plane of the

ecliptic, but deviates from it several degrees. His apparent diameter varies exceedingly. His mean apparent diameter is 27″, and it increases so much, that when the planet is in opposition, the apparent diameter is 81″. Then the parallax of Mars becomes sensible, and about double that of the sun. The disk of Mars changes its form relatively to its position with regard to the sun, and becomes oval. Its phases show that it derives its light from that luminary. The spots observed on its surface have informed astronomers that it moves round its axis from West to East in 1.02738 days, and its axis is inclined to the ecliptic at an angle of about 59.70.

They were first observed in 1666 by Cassini at Bologna, with a telescope about 16¼ feet long; and continuing to observe them for a month, he found they came into the same situation in twenty-four hours and forty minutes. The planet was observed by some astronomers at Rome, with longer telescopes, but they assigned to it a rotation in thirteen hours only. This, however, was afterwards shewn by M. Cassini to have been a mistake, and to have arisen from their not distinguishing the opposite sides of the planet, which, it seems, have spots pretty much alike. He made further observations on the spots of this planet in 1670, from whence he drew an additional confirmation of the time the planet took to revolve. The spots were again observed in subsequent oppositions, particularly for several days in 1704, by Maraldi, who took notice that they were not always well defined, and that they not only changed their shape frequently in the space between two oppositions, but even in the space of a month. Some of them, however, continued of the same form long enough to ascertain the time of the planet's revolution. Among these there appeared this year an oblong spot, resembling one of the belts of Jupiter when broken. It did not reach quite round the body of the planet, but had, not far from the middle of it, a small protuberance towards the North, so well defined, that he was thereby enabled to settle the period of its revolution at twenty-four hours thirty-nine minutes, only one minute less than what Cassini had determined it to be.

Besides these dark spots, former astronomers took notice that a segment of his globe about the South pole exceeded the rest of his disk so much in brightness, that it appeared beyond them as if it were the segment of a larger globe. Maraldi informs us, that this bright spot had been taken notice of for sixty years, and was more permanent than the other spots on the planet. One part of it is brighter than the rest, and the least bright part is subject to great changes, and has sometimes disappeared.

A similar brightness about the North pole of Mars was also sometimes observed; and these observations are now confirmed by Dr. Herschel, who has viewed the planet with much better instruments, and much higher magnifying powers, than any other astronomer ever was in possession of. His observations were made with a view to determine the figure of the planet, the position of his axis, &c. See Philosophical Transactions, vol. lxxiv.

"The analogy," says Dr. Herschel, "between Mars and the earth, is, perhaps, by far the greatest in the whole solar system. Their diurnal motion is nearly the same; the obliquity of their respective ecliptics not very different. Of all the superior planets, the distance of Mars from the sun is by far the nearest alike to that of the earth; nor will the length of the Martial year appear very different from what we enjoy, when compared to the surprising duration of the years of Jupiter, Saturn, and the Herschel. If then we find that the globe we inhabit has its polar region frozen and covered with mountains of ice and snow, that only partly melt when alternately exposed to the sun, I may well be permitted to surmise, that the same causes may probably have the same effect on the globe of Mars; that the bright polar spots are owing to the vivid reflection of light from frozen regions, and that the reduction of those spots is to be ascribed to their being exposed to the sun. In the year 1781, the South polar spot was extremely large, which we might well expect, as that pole had but lately been involved in a whole twelvemonth's darkness and absence of the sun; but in 1783, I found it considerably smaller than before, and it decreased continually from the 20th of May till about the middle of September, when it seemed to be at a stand. During this last period the South pole had already been above eight months enjoying the benefit of summer, and still continued to receive the sun-beams, though, towards the latter end, in such an oblique direction as to be but little benefited by them. On the other hand, nithe year 1781, the North polar spot which had been its twelvemonth

in the sun-shine, and was but lately returning into darkness, appeared small, though undoubtedly increasing in size. Its not being visible in the year 1783, is no objection to these phenomena, being owing to the position of the axis, by which it was removed out of sight. It has been commonly related by astronomers, that the atmosphere of this planet is possessed of such strong refractive powers, as to render the small fixed stars near which it passes invisible. Dr. Smith relates an observation of Cassini, where a star in the water of Aquarius, at the distance of six minutes, from the disk of Mars, became so faint before its occultation, that it could not be seen by the naked eye, nor with a three feet telescope. This would indicate an atmosphere of a very extraordinary size and density; but the following observations of Dr. Herschel seem to show that it is of much smaller dimensions. "1783, Oct. 26th. There are two small stars preceding Mars, of different sizes; with 460 they appear both dusky red, and are pretty unequal; with 218 they appear considerably unequal. The distance from Mars of the nearest, which is also the largest, with 227 measured 3′ 26″ 20‴. Sometime after, the same evening, the distance was 3′ 8″ 55‴, Mars being retrograde. Both of them were seen very distinctly. They were viewed with a new twenty feet reflector, and appeared very bright. October 27th, the small star is not quite so bright in proportion to the large one, as it was last night, being a good deal nearer to Mars, which is now on the side of the small star; but when the planet was drawn aside, or out of view, it appeared as plainly as usual. The distance of the small star was 2′ 5″ 25‴. The largest of the two stars (adds he), on which the above observations were made, cannot exceed the twelfth, and the smallest the thirteenth or fourteenth magnitude; and I have no reason to suppose that they were any otherwise affected by the approach of Mars, than what the brightness of its superior light may account for. From other phenomena it appears, however, that this planet is not without a considerable atmosphere; for besides the permanent spots on its surface, I have often noticed occasional changes of partial bright belts, and also once a darkish one in a pretty high latitude; and these alterations we can hardly ascribe to any other cause than the variable disposition of clouds and vapours floating in the atmosphere of the planet."

MARSHALLIA, in botany, a genus of the Syngenesia Polygamia Æqualis class and order. Generic character: calyx common, many-leaved, spreading; leaflets linear lanceolate, blunt, concave, almost equal, permanent; corolla compound, uniform, longer than the calyx; stamen filaments five, capillary; pistil germ ovate; pericarpium none; seeds solitary; receptacle chaffy.

MARSHALLING *a coat*, in heraldry, is the disposal of several coats of arms belonging to distinct families, in one and the same escutcheon or shield, together with their ornaments, parts, and appurtenances.

MARSHALSEA *court*, is a court of record originally instituted to hear and determine causes between the servants of the king's household, and others, within the verge; and has jurisdiction of things within the verge of the court, and of pleas of trespass, where either party is of the king's family, and of all other actions personal, wherein both parties are the king's servants; but the court has also power to try all personal actions, as debt, trespass, slander, trover, action on the case, &c. between party and party, within the liberty, which extends twelve miles about Whitehall. The judges of this court are the steward of the king's household, and knight-marshal for the time being; the steward of the court, or his deputy, is generally an eminent counsel. It can try all causes, and sits every week, so that judgment can be obtained in a fortnight or three weeks. It has jurisdiction of all debts above as well as below 40*s*. But if a cause of importance is brought in this court, it is frequently removed into the court of King's Bench, or Common Pleas, by an *habeas corpus cum causa*. This cannot be done unless the debt is above 20*l*. The court would have a great deal of practice, on account of the expedition of it, if it were not confined by having only a fixed number of attornies.

MARSHMALLOW, in botany and medicine. See ALTHÆA.

MARSILEA, in botany, a genus of the Cryptogamia Miscellaneæ. Generic character: calyx common oval; corolla none; stamens, filaments none; anthers several, inserted round each pistil; pistil in each cell several; pericarpium none; seeds as many as there are pistils; receptacle membrane somewhat fleshy, clothing the cells internally. There are three species, natives of France, Italy, and the East Indies.

MARTIN (BENJAMIN), in biography, was born in 1704, and became one of the

most celebrated mathematicians and opticians of his time. He first taught a school in the country; but afterwards came up to London, where he read lectures on experimental philosophy for many years, and carried on a very extensive trade as an optician and globe-maker in Fleet-street, till the growing infirmities of old age compelled him to withdraw from the active part of business. Trusting too fatally to what he thought the integrity of others, he unfortunately, though with a capital more than sufficient to pay all his debts, became a bankrupt. The unhappy old man, in a moment of desperation from this unexpected stroke, attempted to destroy himself; and the wound, though not immediately mortal, hastened his death, which happened the 9th of February, 1782, at 78 years of age.

He had a valuable collection of fossils and curiosities of almost every species; which, after his death, were almost given away by public auction. He was indefatigable as an artist, and as a writer he had a very happy method of explaining his subject, and wrote with clearness, and even considerable elegance. He was chiefly eminent in the science of optics; but he was well skilled in the whole circle of the mathematical and philosophical sciences, and wrote useful books on every one of them; though he was not distinguished by any remarkable inventions or discoveries of his own. His publications were very numerous, and generally useful; some of the principal of them were as follows:

"The Philosophical Grammar; being a View of the present State of Experimental Physiology, or Natural Philosophy," 1735, 8vo. "A New, Complete, and Universal System or Body of Decimal Arithmetic," 1735, 8vo. "The Young Student's Memorial Book, or Pocket Library," 1735, 8vo. "Description and Use of both the Globes, the Armillary Sphere, and Orrery, Trigonometry," 1736, 2 vols. 8vo. "System of the Newtonian Philosophy," 1759, 3 vols. "New Elements of Optics," 1759. "Mathematical Institutions," 1764, 2 vols. "Philologic and Philosophical Geography," 1759. "Lives of Philosophers, their Inventions, &c." 1764, 3 vols. "Miscellaneous Correspondence," 1764, 4 vols. "Institutions of Astronomical Calculation," 3 parts, 1765. "Introduction to the Newtonian Philosophy," 1765. "Treatise of Logarithms." "Treatise on Navigation." "Description and Use of the Air-pump." "Description of the Torricellian Barometer." "Appendix to the Use of the Globes." "Philosophia Britannica," 3 vols. "Principles of Pump-work." "Theory of the Hydrometer." "Description and Use of a Case of Mathematical Instruments." "Ditto of a universal Sliding Rule." "Micrographia, or the Microscope." "Principles of Perspective." "Course of Lectures." "Optical Essays." "Essay on Electricity." "Essay on Visual Glasses, or Spectacles." "Horologia Nova, or New Art of Dialling." "Theory of Comets." "Nature and Construction of Solar Eclipses." "Venus in the Sun." "The Mariner's Mirror." "Thermometrum Magnum." "Survey of the Solar System." "Essay on Island Crystal." "Logorithmologia Nova," &c. &c.

MARTYNIA, in botany, so named in honour of John Martyn, F. R. S. professor of botany at Cambridge, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Bignoniæ, Jussieu. Essential character: calyx five-cleft; corolla ringent; capsule woody, corticate, with a hooked beak, four-celled, two-valved. There are six species.

MARTLETS, in heraldry, little birds represented without feet, and used as a difference or mark of distinction for younger brothers, to put them in mind that they are to trust to the wings of virtue and merit in order to raise themselves, and not to their feet, they having little land to set their foot on.

MASON, a person employed under the direction of an architect in the raising of a stone building. The chief business of a mason is to make the mortar; raise the walls from the foundation to the top, with the necessary retreats and perpendiculars; to form the vaults, and employ the stones as delivered to him. When the stones are large, the business of hewing or cutting them belongs to the stone-cutters, though these are frequently confounded with masons: the ornaments of sculpture are performed by carvers in stones or sculptors. The tools or implements principally used by them are the square, level, plumb-line, bevel, compass, hammer, chissel, mallet, saw, trowel, &c. Besides the common instruments used in the hand, they have likewise machines for raising of great burdens, and the conducting of large stones, the principal of which are the lever, pulley, wheel and axis, crane, &c. See LEVER, &c.

MASONS, *free and accepted*, a very ancient society or body of men, so called, either from some extraordinary knowledge of

masonry or building, which they are supposed to be masters of, or because the first founders of the society were persons of that profession. These are now very considerable, both for number and character, being found in every country in Europe, and consisting principally of persons of merit and consideration. As to antiquity, they lay claim to a standing of some thousand years. What the end of their institution is seems still a secret; and they are said to be admitted into the fraternity by being put in possession of a great number of secrets, called the mason's word, which have been religiously kept from age to age, being never divulged.

MASONRY, in general, a branch of architecture, consisting in the art of hewing or squaring stones, and cutting them level or perpendicular, for the uses of building: but in a more limited sense, masonry is the art of assembling and joining stones together with mortar.

MASSETER, in anatomy, a muscle which has its origin in the lower and interior part of the jugum, and its end at the external superficies of the angle of the jaw.

MASSONIA, in botany, so named from Mr. Francis Masson, a genus of the Hexandria Monogynia class and order. Natural order of Coronariæ. Asphodeli, Jussieu. Essential character: corolla inferior, with a six-parted border; filaments on the neck of the tube; capsule three-winged, three-celled, many-seeded. There are four species, all of them found at the Cape of Good Hope.

MAST, a long round piece of timber, elevated perpendicularly upon the keel of a ship, upon which are attached the yards, the sails, and the rigging, in order to their receiving the wind necessary for navigation. A mast, according to its length, is either formed of one single piece, which is called a pole-mast, or composed of several pieces joined together, each of which retains the name of mast separately. A top-mast is raised at the head or top of the lower mast, through a cap, and supported by the trestle-trees. It is composed of two strong bars of timber, supported by two prominences, which are as shoulders on the opposite sides of the masts, a little under its upper end: athwart these bars are fixed the cross-trees, upon which the frame of the top is supported. Between the lower mast-head and the foremost of the cross-trees a square space remains vacant, the sides of which are bounded by the two trestle-trees. Perpendicularly above this is the foremost hole in the cap, whose after-hole is solidly fixed on the head of the lower-mast. The top-mast is erected by a tackle, whose effort is communicated from the head of the lower-mast to the foot of the top-mast, and the upper end of the latter is accordingly guided into and conveyed up through the holes between the trestle-trees and the cap, as before-mentioned; the machinery by which it is elevated, or, according to the sea-phrase, swayed up, is fixed in the following manner. The top-rope, passing through a block which is hooked on one side of the cap, and afterwards through a hole, furnished with a sheave or pulley on the lower end of the top-mast, is again brought upwards on the other side of the mast, where it is at length fastened to an eye-bolt in the cap, which is always on the side opposite to the top-block. To the lower end of the top-rope is fixed the top-tackle, the effort of which being transmitted to the top-rope, and thence to the heel of the top-mast, necessarily lifts the latter upwards parallel to the lower mast. When the top-mast is raised to its proper height, the lower end of it becomes firmly wedged in the square hole (above described) between the trestle-trees. A bar of wood or iron, called the fid, is then thrust through a hole in the heel of it, across the trestle-trees, by which the whole weight of the top-mast is supported. See Ship *building*.

MASTER *of arts*, is the first degree taken up in foreign universities, and for the most part in those of Scotland; but the second in Oxford and Cambridge; candidates not being admitted to it till they have studied seven years in the university.

Master *in chancery*. The masters in chancery are assistants to the Lord Chancellor and Master of the Rolls; of these there are some ordinary, and others extraordinary: the masters in ordinary are twelve in number; some of whom sit in court every day during the term, and have referred to them interlocutory orders for stating accounts, and computing damages, and the like; and they also administer oaths, take affidavits, and acknowledgments of deeds and recognizances. The masters extraordinary are appointed to act in the country, in the several counties of England, beyond ten miles distance from London; by taking affidavits, recognizances, acknowledgments of deeds, &c. for the ease of the suitors of the court.

Master *of the horse*, a great officer of

the crown, who orders all matters relating to the king's stables, races, breed of horses; and commands the equerries and all the other officers and tradesmen employed in the king's stables. His coaches, horses, and attendants, are the king's, and bear the king's arms and livery.

MASTER *of the rolls*, a patent officer for life, who has the custody of the rolls of parliament, and patents which pass the great seal, and of the records of chancery, as also commissions, deeds, and recognizances, which, being made of rolls of parchment, gave rise to the name.

In absence of the chancellor he sits as judge in the court of chancery: at other times he hears causes in the rolls chapel, and makes orders; but all hearings before him are subject to appeal before the chancellor. He hath a writ of summons to parliament, and sits on the second wool-pack next the lord chief justice.

In his gift are the six clerks in chancery, the examiners, three clerks of the petty bag, and the six clerks of the rolls chapel, where the rolls are kept. The rolls house is for his habitation, &c. By statute 23 George II. c. 25. 1200*l.* per annum is directed to be paid to the master of the rolls.

MASTER *of a ship*, the same with captain in a merchant-man; but in a king's ship he is an officer who inspects the provisions and stores, and acquaints the captain of what is not good, takes particular care of the rigging and of the ballast, and gives directions for stowing the hold; he navigates the ship under the directions of his superior officer; sees that the log and log book be duly kept; observes the appearances of coasts; and notes down in his journal any new shoal or rocks under water, with their bearing and depth of water, &c.

MASTER *at arms in a king's ship*, an officer who daily, by turns, as the captain appoints, is to exercise the petty officers and ships company, to place and relieve centinels, to see the candles and fire put out according to the captain's orders, to take care the small arms are kept in good order, and to observe the directions of the lieutenant at arms.

MASTER *of the Temple*, since the dissolution of the order of the Templars, the spiritual guide and pastor of the temple is so called, which was the denomination of the founder and his successors.

MASTER *of the wardrobe*, an officer under the Lord Chamberlain, who has the care of the royal robes, as well as the wearing apparel, collar, George, and garter, &c. He has also the charge of all former kings and queens robes remaining in the Tower, all hangings, bedding, &c. for the king's house, the charge and delivery of velvet and scarlet allowed for liveries. He has under him a clerk of the robes, wardrobe keeper, a yeoman, &c.

MASTER, *quarter*. See QUARTER.

MASTERS and SERVANTS. In London and other places, the mode of hiring is by what is commonly called a month's warning, or a month's wages; that is, the parties agree to separate on either of them giving to the other a month's notice for that purpose, or in lieu thereof, the party requiring the separation to pay or give up a month's wages. But if the hiring of a servant be general, without any particular time specified, it will be construed to be an hiring for a year certain; and in this case, if the servant depart before the year he forfeits all his wages. And where a servant is hired for one year certain, and so from year to year, as long as both parties shall agree, and the servant enter upon a second year, he must serve out that year, and is not merely a servant at will after the first year. If a woman servant marry, she must nevertheless serve out her term, and her husband cannot take her out of her master's service.

If a servant be disabled in his master's service, by an injury received through another's default, the master may recover damages for loss of his service. Which is the foundation also of an action where the servant, even though she is the child of the master, is seduced.

And a master may not only maintain an action against any one who entices away his servant, but also against the servant; and if, without any enticement, a servant leaves his master without just cause, an action will lie against another who retains him with a knowledge of such departure.

A master has a just right to expect and exact fidelity and obedience in all his lawful commands; and to enforce this, he may correct his servant in a reasonable manner, but this correction must be to enforce the just and lawful commands of the master.

In defence of his master, a servant may justify assaulting another, and though death should ensue, it is not murder, in case of any unlawful attack upon his master's person or property.

Acts of the servant are, in many instances, deemed acts of the master; and he is an-

swerable for them when they are pursuant to his authority.

If a servant commit an act of trespass by command or encouragement of his master, the master will be answerable. But in so doing his servant is not excused, as he is bound to obey the master in such things only as are honest and lawful.

If a servant of an innkeeper rob his master's guest, the master is bound to make good the loss. Also, if a waiter at an inn sell a man bad wine, by which his health is impaired, an action will lie againt the master: for his permitting him to sell it to any person is deemed an implied general command. In like manner, if a servant be frequently permitted to do a thing by the tacit consent of his master, the master will be liable, as such permission is equivalent to a general command.

If a servant is usually sent upon trust with any tradesman, and he takes goods in the name of his master upon his own account, the master must pay for them. And, also, if he is sent sometimes on trust, and at other times with money. But if a man usually deals with his tradesmen himself, or constantly pays them ready money, he is not answerable for what his servant may take up in his name; for in this case there is not, as in the other, any implied order to trust him.

So it is if the master never had any personal dealings with the tradesmen, but the contracts have always been between the servant and the tradesman, and the master has regularly given his servant money for payment of every thing had on his account, the master shall not be charged.. Or if a person forbid his tradesman to trust his servant on his account, and he continues to purchase upon credit, he is not liable.

The act of a servant, though he has quitted his master's service, has been held to be binding upon the master, by reason of the former credit given him on his master's account, and its not being known to the party trusting that he was discharged.

The master is also answerable for any injury arising by the fault or neglect of his servant when executing his master's business. But if there be no neglect or default in the servant, the master is not liable.

If a smith's servant lame a horse whilst shoeing him, or the servant of a surgeon make a wound worse, an action for damages will lie against the master, and not against the servant. But the damage must be done whilst the servant is actually employed in his master's service, otherwise he is liable to answer for his own misbehaviour or neglect.

A master is likewise chargeable, if his servant cast any dirt, &c. out of the house into the common street; and so for any other nuisance occasioned by his servants, to the damage or annoyance of any individual, or the common nuisance of his majesty's subjects.

A servant is not answerable to his master for any loss which may happen without his wilful neglect; but if he be guilty of fraud or gross negligence, an action will lie against him by his master.

A master is not liable in trespass for the wilful act of his servant, as by driving his master's carriage against another, done without the direction or assent of his master, no person being in the carriage when the act was done. But he is liable to answer for any damage arising to another from the negligence or unskilfulness of his servant acting in his employ, as for negligently driving against another.

MASTICATION, in medicine, the action of chewing, or of agitating the solid parts of our food between the teeth, by means of the motion of the jaws, the tongue, and the lips, whereby it is broken into small pieces, impregnated with saliva, and so fitted for deglutition and a more easy digestion.

MASTICH, in the materia medica, when pure is in the form of little round drops or tears, of a very pale amber; a piece recently broken is quite transparent, but by exposure to the air it becomes somewhat inclining to the form of powder. When slightly warmed this resin has a faint and rather pleasant odour, which becomes stronger and more grateful when it is melted. In its chemical properties, mastich does not much differ from the other resins. If it is digested in alcohol it is separated into two portions; the one soluble in the spirit, the other insoluble: the former composes four-fifths of the whole, and is pure resin; the latter, in most of its properties closely resembles caoutchouc. In Turkey, mastich is in great request among women as a masticatory; and the produce of China is appropriated solely to the use of the Emperor's seraglio. In other countries it is employed, medically, in fumigations; and by painters and other artists, in the composition of the tougher kinds of varnishes.

MASTOIDES, in anatomy, the same with mammillaris; being applied to such

processes in the body as have the appearance of breasts or dugs, arising in a broad basis, and terminating in an obtuse top. Mastoides is sometimes applied to the muscle which stoops the head, proceeding from the neck-bone and breast-bone, and terminating in the process of the mammiformis. See MAMMILLARY *gland*.

MATCH, a kind of rope slightly twisted, and prepared to retain fire for the uses of artillery, mines, fire-works, &c. It is made of hempen tow, spun on the wheel like cord, but very slack; and is composed of three twists, which are afterwards again covered with tow, so that the twists do not appear: lastly, it is boiled in the lees of old wines. This, when once lighted at the end, burns on gradually and regularly, without ever going out, till the whole be consumed: the hardest and driest match is generally the best.

MATERIA *medica*. It is a subject of curiosity rather than of use, to enquire by what means mankind were induced in the first instance to have recourse to substances, when in a state of disease, which for the most part, they abhor and fly from when in a state of health; and how they came to discern that in these substances chiefly, nature has treasured up the remedies of sickness, the restoratives of a vitiated or debilitated constitution. From whatever source this knowledge has been derived, we feel it daily to be a knowledge of a very important character, and we are sensible of its having been very generally diffused at a very early period of ancient history. Accident in the first instance, and experience confirming the result of some fortunate discovery, were perhaps the chief foundation of therapeutic science in the simplest and rudest ages of the world. Yet the whole can by no means be traced to this source, for the general fallacy of experience, is sufficient to prove that it has had but a very small share in establishing the virtues which have been ascribed to most medicines; and it was probably from a too frequent disappointment in practice, from palpable proof of the uncertainty of those remedies which are recommended by the ancients, that physicians in times comparatively modern have been induced to seek for means, not only of ascertaining more exactly the qualities of established medicines, but of investigating the virtues of substances altogether new and untried.

Hence unquestionably the union of chemistry with the art of healing; for among the earliest chemists we meet with the first attempts at departing from the usual catalogue of medicines in pursuit of a new list. Paracelsus led the way by introducing the absurd notion of astral influences and of signatures; to which succeeding and more rational chemists suggested the utility of a chemical analysis. The doctrine of astral influences and of signatures, has been altogether exploded for a long time, though we still trace certain vestiges of its former existence in many of our latest publications on the Materia Medica. Chemical analysis, as it ought to do, has completely triumphed over the two former systems, and is daily extending its enquiries. To arts, manufactures, and commerce, these enquiries have been pre-eminently useful, nor have they been without their benefit to medicine; yet the benefit resulting from this last application has by no means been equal to that which has resulted to the two former.

The means then resorted to in the present day for determining substances to be remedial or medicinal, or in other words the previous steps to their introduction into the Materia Medica, are their own sensible qualities, their botanical affinity, their chemical examination, and general experience.

Having introduced them into the medical catalogue, our two next subjects of consideration, are their classification or arrangement, and the best mode of employing them, whether simply, and on account of their own specific virtues, or in connection with other substances, by which their proper qualities are so intermixed with the qualities of the other substances employed, as to acquire an increased, a diminished, or altogether a new action; and consequently to be productive of a different result.

The former consideration alone belongs, strictly speaking, to the present article; the latter constituting the proper subject of pharmacy or compound medicine. For the theory and practice, therefore, of combining and compounding medicinal substances, we refer our readers to the article PHARMACY; and shall here confine ourselves, as strictly as we may be able, to the materials actually employed in medicine, on account of their own supposed inherent virtues, and which for the most part are denominated simples.

What ought to be the classification of these materials? This is a question which has often been agitated, and almost as often answered in a different manner: whence the arrangement of different writers is as

different as possible, as founded upon some supposed superior advantage, or even the mere fancy of the author himself. The most simple arrangement is that of an alphabetic form, and it has taken place in most of the dispensatories and pharmacopœias of modern times; but it conveys no practical information, indicates no specific virtue, communicates no scale of comparative power. Another arrangement is that founded upon the quarter or kingdom from which the material is derived; and of course under this system the Materia Medica is divided into the three grand classes of animal, vegetable, and mineral substances. Yet this arrangement does not appear to be of much more advantage than the preceding; the plan is even less simple, and the knowledge it communicates is too trivial to be of any importance. Another, therefore, and a better distribution is founded upon the sensible and more obvious qualities of the substances employed in medicine; from their being acid, absorbent, glutinous, unctuous, astringent, saccharine, acrid, aromatic, bitter, emetic or cathartic. For this classification we are indebted to Cartheuser; it is highly ingenious, and so far as it is applicable, of considerable utility. But it labours under the defect of being incapable of general application.

There are many simples, for example, and those even of great power and activity, in which we can distinguish no predominant sensible quality; there are many, again, in which various qualities are so equally united, that they have just the same claim to a position under one class or order as under another; and there are many, also, which though similar in their sensible qualities, are very dissimilar in their effects upon the animal frame: thus, though gentian and aloes agree in possessing a bitter taste, and sugar and manna in being sweet, their medical virtues are widely different. Accordingly Cartheuser himself is compelled to deviate occasionally from his general plan, and to found a part of his division on the medicinal effects of his materials; introducing not only a class of purgatives and emetics, but of vaporose inebriants and narcotics; under which last class he arranges tobacco, elder-flower, saffron, opium, and poppy-seeds, substances, certainly, very discordant in all the qualities that relate to medicinal intentions.

The last division we shall notice is that of Vogel, who has classified his materials according to their effects on the human body. Some are found to have the property of rendering the solid parts of the frame more lax than before, and are hence denominated relaxing medicines; others possess a directly contrary power, and are consequently called indurating medicines. A third kind are found to excite inflammation in the part to which they are applied, and are therefore named inflammatory; while a fourth from being perceived to increase or diminish the vigour of the body, or what is called the tone of the solids, have acquired the name of tonics in the first instance, and sedatives in the second. Some, again, are conjectured neither remarkably to increase, nor diminish the tone of the solids; but to perform their office either by correcting some morbid matter in the body, or by evacuating it; in the former case they are called alterants, in the latter evacuants.

These are the general divisions or classes into which simple medicines are partitioned under this system; but when we begin to consider their virtues more particularly, a variety of inferior divisions must necessarily ensue. Thus, of the relaxing medicines, some, when externally applied, are supposed merely to soften the part; and in such case are called emollients; while others which are supposed to have a power of augmenting the disposition of the secernents of an inflamed part to the secretion of pus, are called maturants or suppuratives. Sedative medicines, that have the power of assuaging pain, are denominated paregorics; if they altogether remove or destroy pain, they are called anodynes; if they take off spasm, antispasmodics; if they produce quiet sleep, hypnotics; if a very deep, and unnatural sleep, together with considerable stupefaction of the senses, narcotics. Tonic medicines, in like manner, obtain the name of corroboratives, analeptics, or nervines, when they slightly increase the contractile power of the solids; but of astringents or adstringents, if they do this in a great degree. Some of this order of medicines have been supposed to promote the growth of flesh, to consolidate wounds, and restrain hæmorrhages, and hence the names of sarcotics and traumatics, or vulneraries, names, however, which may well be dispensed with, as the quality is very questionable, and perhaps altogether erroneously ascribed. Other astringents, again, are denominated repellent, discutient, stimulant, or attractive, according to the respective modes by which they are conceived to produce one common effect. Medicines of

the inflammatory tribe, are, in like manner, divided into vesicatories or blisters, if by their application they raise watery bladders on the skin; cathæretics, escharotics or corrosives, if they eat into and destroy the substance of the solid parts themselves; and rubefactive or rubefacient, if possessed of less power than the vesicatories, they merely produce a redness on the part to which they are applied, by increasing the action of a part, and stimulating the red particles of the blood, into vessels which do not naturally possess them. The alterant tribe is divided into absorbents, antiseptics, coagulants, resolvents, calefiants, and refrigerants, according to the peculiar mode by which the different individuals of this tribe are supposed to operate. The evacuants are generally subdivided from the nature of the humour they are supposed to discharge: emetics, if they evacuate the contents of the stomach by vomiting; cathartics, if they induce purging; laxatives, if they produce a moderate discharge of feces without pain or sickness; eccoprotics, if the discharge be greater, but still confined to the common nature of the feces themselves. Thus again they are named diaphoretics, if they promote the expulsion of humours through the pores of the skin with a small increase of action; sudorifics, if the increase of action be greater, and the discharge more copious. Such as excite urine are called diuretics; such as produce evacuation from the glands of the palate, mouth, and salivary ducts, salivating medicines; those that promote the discharge of mucus from the throat, apophlegmatics; those that evacuate by the nose, ptarmics; errhines, sternutatories; and those which promote the menstrual discharge, emenagogues. To this order, also, some writers reduce those medicines which expel any preternatural bodies, as worms, stones, and flatus or confined air: of these the first are called anthelmintics; the second, and especially when directed to the bladder, lithontriptics; and the third, carminatives.

Such is the general outline of those who have adopted this kind of system. But it must be obvious that though the general outline be the same, it may submit to a great variety of modifications; and hence, again, the writers who have made choice of this system, and founded their classifications upon the effects produced by the articles of which they have treated upon the human body, have arranged it in various ways according to their respective ideas of superior utility or convenience. Hence the classes of Cullen amount to twenty-three; those of Darwin to not more than seven, while others have given us twelve, fourteen or fifteen according to their own fancy.

The twenty-three classes of Dr. Cullen are as follow:

Astringents	Antacids
Tonics	Antalkalines
Emollients	Antiseptics
Corrosives	Errhines
Stimulants	Silagogues
Narcotics	Expectorants
Refrigerants	Emetics
Antispasmodics	Cathartics
Diluents	Diuretics
Attenuants	Diaphoretics
Inspissants	Menagogues.
Demulcents	

The seven classes of Dr. Darwin are the ensuing:

Nutrients	Invertents
Incitants	Revertents
Secernents	Torpents.
Absorbents	

It will appear, even upon a superficial examination of the former of these classifications, that the first division is unnecessarily diffuse: that some of the divisions might be introduced under one common head, as for example those of emollients and demulcents; diluents and attenuants; and that for one or two of them there is little foundation in nature. We particularly allude in this last instance to the antalkalines, which are obviously only introduced as a sort of graceful contrast to the antacids; and concerning which the writer himself observes, "had it not been to give some appearance of system, and from my complaisance to Dr. Boerhaave who treats *de morbis ex alkali spontaneo*, I should not have admitted of this chapter; for I am well persuaded that no alkaline salt, in its separate state, ever exists in the blood vessels of the living human body." This is not the only instance, however, in which we find men of judgment and deserved reputation consenting to propagate errors from the mere love of system, or from attachment to names of extensive celebrity. Happy would it be for us that all who thus act, should avow their error like the author before us, and thus put the remedy by the side of the evil!

The classification of Dr. Darwin, however, labours under still stronger objections.

Instead of being too diffuse, it is too contracted, for we may defy the warmest supporter of the Darwinean school to simplify, and arrange the whole of what is included in the preceding classification, or that ought to be so included, under the present. But it has a fault still more prominent; and that is, it is adapted to an individual nosology, we mean the nosology of the author himself, and this a nosology, which in some of its divisions is perhaps founded on mere fancy, and consequently has no chance of a permanent or general adoption. His invertentia and revertentia depend upon actions, which to say the least of them are highly doubtful, and have for some years been gradually sinking into disbelief.

Between these two extremes we have had a variety of arrangements of late years, one of the best of which perhaps, is Dr. Kirby's, published in a small tract, entitled "Tables of the Materia Medica," which, with a chemical, and a miscellaneous division, consists of eighteen classes; but to both of which we cannot but object; to the first as it enters too deeply into the department of pharmacy, for a mere list of the materials of medicine; and to the second as evincing a carelessness, or want of methodizing talent, which we should not have expected, and a total departure from every system whatever. We shall nevertheless avail ouselves of its general merit as far we may be able, and endeavour to correct its deficiencies.

There is, however, another point to which we must advert before we proceed to our classification: and that is the nomenclature by which the different substances ought to be distinguished. Till of late, from the use of different nomenclatures by different colleges of medicine, and an absurd intermixture of several of them by some writers, the whole has been a scene of perplexity and confusion. Within the last six or seven years, however, a disposition has been progressively evinced to simplify and generalize the technology, and render the descriptions more accurate. The language of Linnæus has been resorted to as by common consent, throughout the three kingdoms of animals, vegetables and minerals; and though the chemical vocabulary of Lavoisier has not yet been generally introduced, it is daily gaining ground in the publications of individual writers, and has been admitted in its utmost latitude into one or two of our collegiate pharmacopœias. The college of Edinburgh, as it has long led the way as a medical school, has also taken the lead in this instance, and has the honour of having first composed a pharmacopœia, in the pure and unmixed language of science, by its last edition, published in November 1804. The Dublin College has followed its example, by a very excellent specimen alterum, published about six months ago; and at length the College of London, stimulated by such noble incentives, has also roused itself and is on the point of re-editing its own pharmacopœia, with the modern improvements, of the greater part of which we are even now able to avail ourselves from the possession of one of the few copies, which have been worked off as specimens, and circulated amidst the members of the college, and the best informed medical practitioners, for the purpose of marginal remarks, before the publication of the work in a finished state. In its general nomenclature it will be found not to vary essentially from the nomenclature of the Edinburgh pharmacopœia, and especially in that part of it which relates to the Materia Medica, the immediate object before us.

We freely confess our surprise that from the errors resulting from a promiscuous use of weights and measures, nothing either general or very decisive, has been attempted by either of the two new, or the projected pharmacopœia. It would have added largely to the reputation of the intended edition of the London College, if it had adopted the decimal and applicable mensuration of the French Institute, at the same time that it consented to admit the French nomenclature. It has not, however, been altogether inactive upon this subject, for it has thrown away the unscientific and indecisive measure of drops, and has instituted that of grains in its stead, so that a drop in the forth-coming edition will be found to answer to a grain in the same manner as a pint answers to a pound, the Troy weight being, still continued as heretofore: and of course a scruple will intimate twenty grains of liquids as well as of solids. We shall only observe further, that the Edinburgh College has expressed an intractable abhorrence of all measures of medicines, whatsoever, and in consequence has rejected their use in every instance: so that in the Edinburgh forms, the liquids of every kind, are supposed to be employed by weight alone.

In the ensuing classification we have been anxious to give our readers a general

and concentrated view, as far as we have been able, not only of the substances employed, but of the mode and preparation in which they are exhibited by the different pharmacopœias at present extant, we may be told, perhaps, that we are hereby, in some measure, entrenching upon the province of Pharmacy, properly so called. We are not insensible to the remark: but we hereby gain an advantage which no other plan could present to us; we offer at one and the same time a table of comparative statements, and show the various forms in which the same material becomes an official drug. We have also been anxious to exhibit, in every instance, a glance at the common dose for adult age, as well as to specify in terms as abbreviated as possible, the name of the country in which the different articles exist indigenously; the part or organ of the substance employed; and the disease in which it is supposed to be efficacious. The classification is as follows, and every class is subdivided as far as possible into an animal, a vegetable and a fossile section.

Emetics	Refrigerants
Expectorants	Astringents
Diaphoretics	Tonics
Diuretics	Stimulants
Cathartics	Antispasmodics
Emmenagogues	Narcotics
Errhines	Anthelmintics
Sialagogues	Absorbents.
Emollients	

CLASS I. EMETICA.

SECT. I. ANIMALIA.

Murias Ammoniæ. Edin.
Sal ammoniacum. Lond. Dub.
Britannia.
Aq. carbonatis ammoniæ. E.
Aq. ammoniæ. L. } dr. 1—2.
Liquor alkali volat. mitis. D.

SECT. II. VEGETABILIA.

Anthemis nobilis. E.
Chamæmelum. L. D.
Brit. Flos. Infus. dr. 2—4. ad. aq. lib. ½.
Asarum europæum. E.
Asarum. L. D.
Brit. Ital. Folia. Pulv. dr. ½—1.
Centaurea benedicta.
Carduus benedictus. L.
Insul græc. Folia. infus. vel decoct.
Cephælis ipecacuanha.
Ipecacuanha. L. E. D.
India occid. Brasil. Radix. Pulv. gr. 15—25.
Vinum ipecacuanhæ. L. E. D. unc. 1—2.
Nicotiana Tabacum. E.
Nicotiana. L.
America. Folia. Fum. Cataplasm.
Olea europæa. E.
Oliva. L. D.
Europ. merid. Fructus oleum express.
Ad Venena.
Scilla maritima. E.
Scilla. L. D.
Eur. merid. Rad. Pulv. gr. 4—10.
Acetum. Scillæ marit. E.
Acet. scillæ. L. D. unc. ½—1.
Sinapis alba. E.
Sinapi. L. D.
Brit. Seminis pulvis aqua commixt. dr. 1.

SECT. III. FOSSILIA.

Sulphas Cupri. E.
Cuprum vitriolat. L. D.
Brit. Solut. gr. 2—5.
Ad Venena.
Sulphuretum antimonii. E.
Antimonium. L. Stibium. D.
Brit.
Oxidum Antimonii cum Sulphur. vitrificat. E.
Antimonium vitrificatum L.
Vinum Antimonii L.
Tartris Antimonii E.
Antimonium tartarisatum. L. } gr. 1—4. dos. repetit.
Tartarum Stibiatum. D.
Vinum Tartrit. Antimon. E. unc. ½—1½.
Antimon. tartar. L.
Tartari stibiat. D. dr. 2—6.
Zincum E.
Sulphas Zinci E. } gr. 10—30.
Zincum vitriolatum. L. D.

CLASS II. EXPECTORANTIA.

SECT. I. VEGETABILIA.

Cephælis Ipecacuanha. Pulv. gr. 1. 3tia aut 4ta qu. hor.
Peripneumon. noth. Asthma.
Nicotiana Tabacum. Fumus.
Scilla maritima.
Acet. Scil. maritim. dr. 2—4
Syrup Scill. maritim. E.
Oxymel Scillæ. L. D.
Tinctura Scillæ. L. gt. 10—dr. 1.
Pilulæ Scillæ. L. D. } gr. 10—15.
Scilliticæ. E.
Conserva Scillæ, L. gr. 30—40.
Allium sativum. E.

Allium. L. D.
Eur. merid. Rad. recens. dr. 1—2.
Syrupus Allii. L. coch. 1. subinde.
Ammoniacum. E. L. D.
India. Gum-resin. Pil. Mist. gr. 10—20. dos rep.
Lac Ammoniaci. L. unc. 1—2. dos rep.
Arum maculatum. E.
Arum. L.
Brit Rad. recens.
Conserv. Ari. L. dr. ½—1.
Colchicum autumnale. E.
Colchicum. L.
Brit. Rad. recens.
Syrupus Colchici autumnal. E. dr. 2—
Oxymel Colchici. L. unc. 1.
Ferula Asa fœtida. E.
Asa fœtida. L. D.
Persia. Gum-resin. Pil. mist. gr. 10—15. dos. rep.
Lac Asæ fœtidæ. L. unc. 1—2. dos. rep.
Hyssopus officinalis.
Hyssopus. D.
Brit. Herba.
Marrubium vulgare. L.
Brit. Folia. Syrup.
Myrrha. L. E. D.
Arab. Abyssin. Gum-resin. Pul. Pil. gr. 10—dr. ½.
Pimpinella Anisum. E.
Anisum. L. D.
Asia. Semin. Infus.
Ol. volat. Pimpinell. Anisi. E.
Essent Anisi. L. gr. 2—6.
Polygala Senega. E.
Seneka. L. D.
Amer. Rad.
Decoctum. Polygal. Senegæ. E. unc. 1—1½.
Cynanch. tracheal. Pneumon.
Styrax Benzoin. E.
Benzoinum. D.
Benzoe. L.
Sumatra. Balsam.
Acidum Benzoicum. E.
Sal Benzoini. D. gr. 1—2. dos.
Flores Benzoes. L. repet.
Tinct. Benzoes. compos. L. gt. 15—30.
Alcohol.
Spirit. Vini rectificat. L. D.
Æther Sulphuricus. E. forma vaporis.
vitriolicus. L. D.
Asthma.

SECT. II. FOSSILIA.

Sulphuretum Antimonii.
Tartris Antimonii. gr. ¼—½. subinde.
Vinum Tartrit. Antimonii. E. dr. 1—2.
Antimonii tartaris. L. D. gt. 30—d. 1.
Sulphuretum Antimonii precipitat. E*.
Sulphur Antimonii præcip. L. gr. 3-5.
Stibii rufum. D.
Sulphur sublimatum. E.
Flores Sulphuris. L. D.
Sulphur sublimat. lotum. E. gr. 15—
Flores Sulphuris loti. L. D. dr. ½.
Oleum Sulphuratum. L. D. E. gt. 10—20.
Petroleum Sulphuratum. L.
Trochisci Sulphuris. L.
Asthma, &c.

* This should have been called *Hydrosulphuretum*.

CLASS III. DIAPHORETICA.

A. *Mitiora.*

SECT. I. ANIMALIA.

Murias Ammoniæ.
Aqua Carbonat. Ammoniæ. gt. 50.
Carbonas Ammoniæ. E.
Ammonia præparata. L. gr. 5—10.
Alkali volatile mite. D.
Alcohol Ammoniatum. E.
Spirit. Ammoniæ. L. gt. 30—
Alkali volatil. D. dr. 1.

SECT. II. VEGETABILIA.

Anthemis nobilis.
Infus. calid.
Centaurea Benedicta.
Ibid.
Myrrha.
Pulv.
Allium sativum.
Acidum Acetosum.
Acetum. L. D.
Serum lactis Aceto coacti.
Rheumatism.
Acidum Acetosum destillat. E.
Acetum distillatum. L. D.
Aqua Acetitis Ammoniæ. E.
Ammoniæ acetatæ. L. dr. 3—6.
Liq. Alkali volat. acetat.
Arctium Lappa. E.
Bardana. L. D.
Brit. Rad. Decoct.
Artemisia Abrotanum.
Abrotanum. L.
Eur merid. Folia. Infus.
Aristolochia Serpentaria. E.
Serpentaria. L. D.
Americ. Rad. Pulv. gr. 20—30. 6ta quaq. hor.

Tinctur. Aristoloch. Serpentar. E. } dr. 3-6.
Serpentar. L.
Daphne Mezereum. E.
Mezereum. L.
Mezereon. D.
Eur. septentr. Radicis cortex. Pulv. gr. 1.
Decoctum Daphnes Mezerei. E. unc. 1—2.
Syphil. Morb. cutan.
Dorstenia Contrajerva. E.
Contrayerva. L. D.
Amer. merid. Rad. Pulv. gr. 30—40.
Decoct.
Febr. Cynanch.
Pulv. Contrajerv. comp. L. gr. 30—40. 4ta. qu. hor.
Fumaria officinalis.
Fumaria. D.
Brit. Herba. Infus.
Laurus Sassafras. E.
Sassafras. L. D.
Amer. sept. Ling. Rad. Cort. Decoct.
Salvia officinalis. E.
Salvia. L. D.
Eur. mer. Folia. Infus. ad libitum.
Sambucus nigra. E.
Sambucus. L. D.
Brit. Baccæ. Succus expressus.
Succus baccæ Sambuc. spissat. L.
Smilax Sarsaparilla. E.
Sarsaparilla. L. D.
Ind. Occ. Rad. Decoct.
Decoctum Smilac. Sarsaparill. E. } lib. 1. — in die.
Sarsaparill. L. D.
compos. L. Ibid.
Ad morbos cutan.
Solanum Dulcamara. E.
Dulcamara. E.
Brit. Stipites. Decoct.
Supertartris Potassæ. E.
Crystalli Tartari. L. D.
Gallia, &c. Pulv. Solut. scr. 1—dr. 1. sæpius in die.

B. *Fortiora.*

SECT. I. ANIMALIA.

Moschus moschiferus. E.
Moschus. L. D.
Asia. Mætries prope Umbilic. collecta. Bol.
Haust. gr. 10—20.
Mistura moschata. L. unc. 1—2.

SECT. II. VEGETABILIA.

Aconitum neomontanum.
Aconitum napellus. L. E. D.
Eur. mer. Folia. Pulv. Tinctur. gr. $\frac{1}{2}$—2.
Succus spissat. Aconit napell. E. gr. $\frac{1}{2}$—2.
Rheumat. Podagr. Paralys.
Guaiacum officinale. E.
Guaiacum. L. D.
Ind. Occ. Ling.
Cort. Dec. Gum-resin. Pulv. Pil. Emuls. gr. 10—30.
Decoct. Guaiaci offic. comp. E. lib. $\frac{1}{2}$—1. in die.
Ad. morb. cutan.
Tinctur. Guaiac. offic. dr. 2—4.
Ammoniæ. E. } dr. 1—3.
Guaiaci. L.
volatilis. D.
Rheumatism.
Laurus Camphora. E.
Camphora. L. D.
Ind. Orient. Bol. Mist. gr. 5—20.
Mistura Camphorata, L. unc. 2—4.
Emulsio Camphorata. E. unc. 1—3.
Papaver somniferum. E.
Pap. album. L. D.
Opium.
Asia. Succus spiss. capsul. Pil. Pulv. gr. 1—2.
Tinctura Opii. L. E. D. gt. 25—50.
Tinct. Opii camphorat. L. dr. 2—6.
Ammoniata. E. dr. 1—1$\frac{1}{2}$.
Pulv. Ipecac. et Opii. E. } gr. 10—20.
compos. L. D.
Rhododendron Chrysanthum. E.
Siberia. Fol. Summit. Decoct. dr. 2—4. ad lib. 7.—unc. 1—2. bis in die.
Rheumat. Podagr.

SECT. III. FOSSILIA.

Sulphuretum Antimonii.
Tartris Antimonii gr. $\frac{1}{4}$. 6ta qu. hora.
Vinum Tartrit. Antimon. E. dr. 2.
Antimon. tartar. L. dr. 1.
Sulphuret. Antimon. præp. gr. 1—2.
Sulphur Stibii fuscum. D. Gr. 1—1$\frac{1}{2}$.
Oxidum Antimon. cum phosphate Calcis. E. } gr. 4—6. 4ta aut 6ta quaq. hor.
Pulvis Antimonialis L.
Stibiatus D.
Antimonium calcinatum L. gr. 10—15.
Calx Stibii præcipitat. D.
Febres. Cynanchen. Pneumon. Rheumat. Variol. Rubeol. Scarlatin. Catarrh.
Dysenter, &c.
Sulphur sublimatum.
Sulph. sublimat. lat E. } gr. 12—30.
præcipitat. L.

Hydrargyrum.
Hydrargyrus. L. E. D.
Hungaria, &c.
Hydrargyr. purificat. L. E. D.
Submurias Hydrargyr. E. }
Calomelas. L. } gr. 1. omn.
Hydrarg. muriat. mit. } nocte.
sublim. D. }
Rheumat.

CLASS IV. DIURETICA.

SECT. I. ANIMALIA.

Lytta vesicatoria.
Meloe vesicatoria. E.
Cantharis. L. D.
Eur. mer. Pulv. gr. ½.—1. 4ta vel 6ta qu. hor.
Tinctur. Meloes vesicat. E.
Cantharid. L. gt. 10—20.
Ischur. Hydrop.
Oniscus Asellus. E.
Millepedes. L.
Brit.

SECT. II. VEGETABILIA.

Asarum europæum. Rad. Decoct.
Hydrop.
Nicotiana Tabacum. Infus. unc. 1. ad lib.
1. gt. 60—80.
Hydrop. Dysur.
Scilla maritima. Pulv. gr. 1—2. bis terve in die.
Tinctur. Scilæ. gt. 20—30.
Hydrop.
Allium sativum.
Colchicum autumnale.
Syrup. Colchici. E. }
Oxymel Colchica. L. } dr. 1—4. bis terve in die.
Acetum Colchici. D. }
Hydrop.
Polygala Senega.
Decoct. Polygal. Seneg. unc. 1—1½.
Acidum Acetosum.
Acetis Potassæ. E. }
Kali acetatum. L. } ser. 1—4.
Alkali vegetabile acetat. }
Hydrop. Icterum.
Daphne Mezereum.
Decoct. Daphn. Mezerei. unc. 1—2.
Smilax Sarsaparilla.
Decoct. Sarsaparill. com. ad libit.
Solanum Dulcamara. Decoct.
Supertartris Potassæ Solut. unc. ½. in die.
Hydrop.
Allium Cepa.
Cepa. D.
Cult. Rad. recens ad libit.
Cissampelos Pareira.
Pareira brava. L. D.
Ind. Occid. Rad.
Cochlearia Armoracia. E.
Raphanus rusticanus. L. D.
Brit. Rad. recens. Infus.
Hydropes.
Copaifera Officinalis. E.
Balsamum Copaiva. L. Copaiba. D.
Ind. Occ. Amer. Resin. Gutt. Emuls. gtt. 20—60.
Cynara Scolymus.
Cin. Scolymus. E.
Cinara. L. D.
Eur. mer. Folia. Succ. express. unc. ½—1. bis in die.
Hydrop.
Digitalis purpurea. E.
Digitalis. L. D.
Brit. Fol. Pulv. gr. 1. bis in die. Infus. Decoct.
Hydrop.
Juniperus communis.
Juniperus. L. D.
Brit. Bacc. scr. 1—dr. ½. Cacumen. Infus. ad libit.
Spir. Juniper. commun. }
comp. E. } unc. ½—1. dilut. subind.
compos. L. D. }
Ol. Juniper. L. D.
commun. E.
Juniperus Lycia.
Olibanum. L. D.
India. Gum-resin.
Leontodon Taraxacum.
Taraxacum L. D. Rad.
Pinus Sylvestris. E.
Terebinthina vulgaris. L. D.
Brit. Resina et ol. volat. Gutt. Enema. Pill. gr. 15—20.
Ol. Volat. Terebinth rect. gtt. 20—30.
Pinus Larix.
Terebinthina Veneta. L. D.
Brit. Resina. Enema. Pill.
Spartium scoparium. E.
Genista. L. D.
Brit. Sem. Cacum. Decoct. ad libit.
Ulmus campestris. E.
Ulmus. L. D.
Brit. Cort. intern. Decoct.
Decoct. Ulmi. L. unc. 4—8. sæpius in die.
Ad morb. cutan.

SECT. III. FOSSILIA.

Hydrargyrum.
Murias Hydrargyri. E. }
Hydrargyrus muriatus. L. } gr. ⅛—¼.
Hyd. mur. corros. D. }
Ad morb. cutan.

Nitras Potassæ. E.
Nitrum. L. D.
India. Pulv. gr. 5—15.
Nitrum purificat. E. L. u. s.
Acidum Nitrosum. L. E. D. dr. 1—2. ad Aquæ lib. 1. in die.
Spir. æther. nitros. L. E. D. gtt. 30—60. sæp. in die.

CLASS V. CATHARTICA.

A. *Mitiora.*

SECT. I. ANIMALIA.

Mel. L. E. D.
Brit.
Mel despumatum. E. L. D.

SECT. II. VEGETABILIA.

Anthemis nobilis.
Decoct Anthemid. nobil. E. Enema.
Olea europæa. Oleum. Enema.
Supertartris Potassæ. Pulv. dr. 2—4.
Tartris Potassæ. E. / Kali tartarisatum. L. / Alkali vegetabile tartarisat. D. } dr. 2—6.
Tartris Potassæ et Sodæ. E. / Natron tartarisatum. L. / Sal Rupellense. D. } unc. 1—2.
Ad Febres. Phlegmas. Hæmorrhag. Comata. Colicam.
Choleram. Hydropes. Icterum.
Cassia fistula. E.
C. fistularis. L. D.
Ind. Or. et Occ. Fruct. Pulpa. ad libit.
Electuar. Cassiæ. L. / fistul. E. } unc. ½—1.
C. Senna. E.
Senna. L. D.
Ægypt. Folia. Pulv. Infus.
Pulvis Sennæ composit. L. dr. ½—1.
Febres, &c.
Electuar. Cassiæ Sennæ E. / Sennæ. L. D. } dr. 2—6.
Infusum Sennæ. Simpl. L. / Sennæ. D. / tartarisat. L. } unc. 1—3.
Infus. Tamarind. Indic. cum Cass. Senna E. unc. 1—3.
Tinctura Sennæ. comp. E. / Sennæ. L. D. unc. ½—1½.
Colicam.
Ficus Carica.
Carica. L. D.
Eur. mer. Fruct.
Fraxinus Ornus. E.
Manna. L. D.
Eur. mer. Succ. concret. Solut. Elect. unc. 1—1½.
Syrupus Mannæ. D.
Prunus Domestica. E.
Pr. Gallica. L. D.
Eur. mer. Fruct. ad libit.
Rosa Damascena. L. D.
Rosa centifolia. E.
Eur. mer. Petala.
Aq. Rosæ centifolia. E.
Rosæ. L. D.
Syrup. Rosæ. centifol. E.
Rosæ. L. D.
Saccharum officinale. E.
Sacch. non. purificat. L. D.
Ind. Occid. Succ. spissat.
Tamarindus Indicus. E.
Tamarindus L. D.
Ind. Occ. Fruct. Pulpa. unc. 1—2. Infus.
Viola odorata. E.
Viola. L. D.
Brit. Petala. Infus.
Syrupus Violæ odoratæ. E.
violæ. L. D.

SECT. III. FOSSILIA.

Sulphur sublimatum.
Sulphur. sublimat. lotum. dr. 1—2.
Ad Hæmorrhag. Morb. cutan. Obstipat.
Sapo Hispanus. L. E. D.
Hispan. Pil. Enema.
Icterum.

B. *Fortiora.*

SECT. I. ANIMALIA.

Cervus Elaphus. E.
Cervus. L. Cornu cervinum. D.
Phosphas Calcis.
Phosphas Sodæ. E. unc. 1—2.

SECT. II. VEGETABILIA.

Nicotiana Tabacum. Fum. Infus. pro Enemat.
Colicam Obstipat.
Sambucus nigra. Cortex interior Decoct. unc. 1. ad lib. 1. in die.
Hydrop.
Pinus sylvestris / Larix. } Terebinthina Enemat.
Aloe perfoliata. E.
Aloe Soccotrina.
A. Hepatica.
A. Cabalina. L. E. D.
Asia. Ind. Occ. Africa. Gum resin. Pil. gr. 5—20.
Pulv. Aloes cum Canella. L. gr. 8—20.
Pilulæ Aloeticæ E. D. / Aloes compos. L. } gr. 10—20.

Aloes cum Colocynth. L. gr. 10—20.
Vinum Aloes Soccotrin. E. unc. 1—2.
Aloes. L. Aloetic. D. unc. $\frac{1}{2}$—1.
Tinctura Aloes socotrin. E. } unc. $\frac{1}{2}$—
Aloes. L. } $1\frac{1}{2}$
Dyspeps. Hypochondrias. Chloros.
Icter. Obstipat.
Bryonia alba. E.
Bryonia. D.
Brit. Rad. Decoct. Pulv. scr. 1—2.
Maniam. Hydrop.
Convolvulus Jalapa. E.
Jalapium. L.
Jalapa. D.
Amer. Rad. Pulv. Bolus. gr. 15—30.
Pulvis Jalapæ compos. E. dr. $\frac{1}{2}$—1.
Extract. Rad. Convolvul. Jalapæ. E. } gr. 5—12.
Jalapii. L. }
Tinctur. Convolvul. Jalapæ. E. dr. 3—6.
Tinctur. Jalapii. L. T. Jalapæ. D. dr. 2—4.
Conv. Scammonium. E.
Scammonium. L. D.
Asia. Resin. Pulv. Bol. Pil. gr. 5—15.
Pulvis Scammon. comp. L. gr. 8—15.
E. gr. 10—30.
cum Aloe. L. gr. 5—12.
Electuar. Scammonii. L. D. gr. 15—30.
Hydrop. Vermes.
Cucumis colocynthis. E.
Colocynthis. L. D.
Syria. Fructus medulla. Pil. Bol. gr. 2—5.
Extract. Colocynth. comp. L. gr. 5—15.
Gratiola officinalis E.
Gratiola. D.
Eur. mer. Herba. Radix. Decoct. Pulv. gr. 15—30.
Helleborus niger. E. D.
Melampodium.
Eur. mer. Rad. Pulv. Pil.
Extract. Hellebor. nigri. E. gr. 3—6.
Hydrop.
Helleb. fœtidus.
Helleboraster. L.
Brit. Rad. Fol. Decoct.
Iris Pseudacorus.
Iris. D.
Brit. Rad. recens. Succ. express. gtt. 60—80.
Hydrop.
Linum catharticum. D.
Brit. Herba. Infus. Pulv. dr. 1.
Momordica Elaterium. E.
Cucumis agrestis. L.
Brit. Fructus recens.

Succ. spiss. Momordic. Elater. E. } gr. 1—3.
Elaterium. L. }
Hydrop.
Rhamnus Catharticus. E.
Spina cervina. L.
Brit. Bacca. Succ. express.
Syrupus Rhamni cathart. E. } dr.
spinæ cervinæ. L. } 6—12.
Hydrop.
Rheum palmatum. E.
Rhabarbarum. L. D.
Russia. Ind. Rad. Pulv. Bol. Pil. gr. 10—40.
Infusum Rhei palmati. E. unc. 1—3.
Vinum Rhei palmati. E. dr. 2—6.
Vinum Rhabarbari. L. unc. 1—2.
Tinctura Rhei palmat. E. } unc. $\frac{1}{2}$—$1\frac{1}{2}$.
Rhabarbari. L. }
Rhabarbari comp. L. unc. 1.
Rhei et Aloes. E. dr. 4—6.
Gentian. E. dr. 4—6.
Febres. Dysenter. Dyspeps. Hypochond. Icterum.
Ricinus communis. E. L. D.
Ind. Occ. Seminum Ol. express. dr. 3—unc. 1.
Stalagmitis Cambogioides. E.
Gambogia. L. D.
Ind. Gum-resin. Pil. g. 3—15.

SECT. III. FOSSILIA.

Sulphuretum Antimonii.
Tartris Antimonii gr. $\frac{1}{4}$. 4ta. quaq. hor.
Dysenter.
Hydrargyrum.
Submurias Hydrargyri. gr. 1—4.
Submurias Hydrargyri præcipitat. E. }
Hydrargyr. muriat. mitis. L. } gr.
Hydrarg. mur. mit. præcip. D. } 3—10.
Pilulæ Hydrargyri. E. D. L. }
Phlegmas. Comata. Colicam. Icterum, Obstipat. &c.
Nitras Potassæ.
Sulphas Potassæ. E. }
Kali vitriolatum. L. } dr. 1—2.
Alkali vegetabile vitriolat. D. }
Murias Sodæ. E.
Natron muriatum. L.
Alkali fossile muriatum. D.
Brit. Solut. unc. $\frac{1}{2}$—1. Enem.
Sulphas Sodæ. E. }
Natron vitriolatum. L. } unc. 1—2.
Alkali fossile vitriolat. D. }
Sulphas Magnesiæ. E.
Magnesia vitriolat. L. D.

Brit. Solut. Enem. unc. ½—1½.
Dysenter. &c.

CLASS VI. EMMENAGOGA.

SECT. I. ANIMALIA.

Murias Ammoniæ.
Carbonas Ammoniæ.
Castor Fiber. E.
Castor. L. D.
Russia Amer. Mater. prope autum collecta.
Pulv. Pil. gr. 10—20. Enem. scr. 2—dr. 1.
Tinctura Castor. L. E. D. gtt. 20 dr. 1.
compos. E. gtt. 20.—dr. 1.

SECT. II. VEGETABILIA.

Anthemis nobilis. Pulv. Infus. fort.
Extract. Anthem. nobil. E. } gr. 15-30.
Chamæmel. L. D. }
Ammoniacum. Pil. gr. 10.—scr. 1.
Ferula Asa fœtida. Pil. gr. 10—20.
Pil. Asæ fœtid. comp. E. gr. 15—30.
Tinctur. Asæ fœtid. L. E. D. dr. 1—2.
Alcohol. Ammoniat. fœtid. E.
Spir. Ammoniæ fœtid, L. } gtt. 30
Alkal. volatil. fœtid. D. } —dr. 1.
Marrubium vulgare. Infus.
Myrrha.
Pulvis Myrrh. comp. L. gr. 15—20.
Solanum Dulcamara.
Aloe perfoliata. Pil. gr. 1. ter in die.
Pulv. Aloes cum Myrrh. L. gr. 15—30.
Pil. Aloes cum Myrrh. L. gr. 8—15.
E. gr. 5—12.
cum Asa fœtida. E. gr. 10. bis in die.
Tinctura Aloes compos. L. unc. 1.
cum Myrrha. dr. 2—4.
Bryonia alba. Pulv. gr. 10—20.
Helleborus niger.
Tinctura Hellebor. nigr. E. dr. 1. bis in die.
Rheum palmatum. Pulv. gr. 5—10. bis in die.
Pilul. Rhei compos. scr 1 —dr. ½.
Arnica montana. E. L.
German. Flores. Infus. scr. 1—2. in die.
Bubon Galbanum. E.
Galbanum. L. D.
Afric. Gum-resin. gr. 10—20.
Tinctura Galbani. L. dr. 1.
Pilul. Galbani compos. gr. 15—30.
Juniperus Sabina. E.
Sabina. L. D.
Asia. Fol. Pulv. gr. 10—15. bis in die.
Extract. Sabinæ compos. L. D. gr. 5—10. bis in die.
Tinct. Sabinæ L. gtt. 40—60.
Pastinaca Opopanax. E.
Opopanax. L. D.
Eur. mer. Gum-resin. Pil.
Rosmarinus officinalis. E.
Rosmarinus. L. D.
Eur. mer. Summitat. Infus.
Rubia tinctorum. E.
Rubia. L. D.
Brit. Zealand. Rad. Pulv. dr. ½—1. ter in die.
Ruta graveolens.
Ruta. L. D.
Eur. mer. Herba. Infus.
Extract. Rutæ. L. D.
Sagapenum L. E. D.
Ægypt. Gum-resin. Pil.

SECT. III. FOSSILIA.

Hydrargyrum.
Submurias. Hydrargyri. gr. 3—5.
præcip. gr. 5—10.
Pilulæ Hydrargyr. gr. 10—20.
Ferrum. E. L. D.
Brit., &c.
* Carbonas Ferri. E. } scr. 1—dr. 1.
Rubigo Ferri. L. D. } bis in die.
Carbonas Ferri præcip. E. gr. 5—15.
Aqua Ferri Ærati. D. lib. ½.—1. in die.
Sulphas Ferri. E. } gr. 1—5. bis
Ferrum vitriolat. L. D. } in die.
Vinum Ferri. L. dr. 2—4.
Tinctur. Muriatis Ferri. E. } gtt. 10—20.
Ferri muriat. L. D. } bis terve in die.

* The quantity of Carbonic Acid in these two preparations, can scarcely entitle them to the name of Carbonate; they are rather Carbonated Oxyde, or what Dr. Thomson calls Oxy-carbonates.

CLASS VII. ERRHINA.

SECT. I. VEGETABILIA.

Asarum europæum. Pulv.
Pulvis Asari europ. compos. E.
Asari compos. L.
Nicotiana tabacum. Pulv.
Rosmarinus Officinalis. Pulv.
Iris florentina.
Iris. L.
Ital. Rad. Pulv.
Lavandula spica. E.
Lavendula. L. D.
Eur. mer. Flores. Pulv.

Origanum majorana. E.
Majorana. L. D.
Eur. mer. Folia. Pulv.
Teucrium marum.
Marum syriacum. L.
Eur. mer. Herba. Pulv.
Veratrum album. E.
Helleborus albus. L. D.
Eur. mer. Rad. Pulv.

SECT. II. FOSSILIA.

Hydrargyrum.
Subsulphas Hydrarg. flav. E.
Hydrargyr. vitriolat. L. D. } gr. 1. bis in die.

CLASS VIII. SIALAGOGA.

SECT. I. VEGETABILIA.

Daphne Mezereum. Rad. masticat.
Odontalg. Paralys.
Amomum Zingiber. E.
Zingiber. L. D.
Ind. Occ. Rad. masticat. Infus.
Odontalg.
Anthemis Pyrethrum. E.
Pyrethrum. L. D.
Eur. mer. Rad. masticat. Infus.
Pistacia lentiscus. E.
Mastacia. L. D.
Eur. merid. Resina. Masticat.

SECT. II. FOSSILIA.

Hydrargyrum.
Hydrargyrum purificatum.
Submurias Hydrargyri. gr. 1—2. bis in die.
Murias Hydrargyri. gr. $\frac{1}{8}$—$\frac{1}{4}$. bis terve in die.
Submurias Hydrarg. præcip. gr. 2. bis in die.
Pilulæ Hydrargyri. gr. 6—8. bis in die.
Oxidum Hydrargyri cinereum. E.
Pulvis Hydrargyri cinereus. D. } gr. 2. bis in die.
Unguentum Hydrargyr. E. scr. 4.
L. D. scr. 2. fortius
L. D. mitius. } alternis vel singulis noctibus.
Hydrargyr. calcinatum. L. gr. $\frac{1}{2}$. bis in die.
Acetis Hydrargyria. E.
Hydrargyr. acetatum. L. D. } gr. 2.
Hydrargyrus sulphurat. ruber. L. externe.
Sulphuretum Hydrargyri nigrum.
Hydrargyr. cum Sulphure. L.
Hydrargyr. sulphuratus niger. D.
Ad Febrem flav. Phrenit. Hydrocephalic. Ophthalm.
Cynanch. tracheal. Hepatit. chronic. Comata. Tetanum.
Hydrophob. Hydrop. Chloros. Siphilid. Lepr. Icterum. Psoram. Vermes.

CLASS. IX. EMOLLIENTIA.

SECT. I. ANIMALIA.

Acipenser Huso. Sturio., &c. E.
Icthyocolla. L. D.
Russia. Decoct. ad libit.
Ovis Aries. E.
Ovis sevum. L.
Sevum ovillum. D.
Brit. Ungt. Liniment. Cerat.
Physeter macrocephalus. E.
Sperma Ceti. L. D.
Sevum. Unguent., &c.
Sus scrofa. E.
Adeps suillum. L. D.
Brit., &c. Adeps. Unguent., &c.
Linimentum simplex. E.
Unguentum Adipis suillæ. L.
simplex. E.
Unguentum spermatis Ceti. L. D.
Ceræ. L. D.
Ceratum simplex. E.
Spermatis Ceti. L. D.
Cera alba. et flava. E. L. D.
Brit. Emuls. Unguent., &c.
Ad Diarrhœam. Dysenter. Ulcera.

SECT. II. VEGETABILIA.

Olea europæa. Liniment., &c. et interne.
Althea officinalis. E.
Althea. L. D.
Brit. Rad. Decoct. ad libit.
Decoct. Altheæ officinal. E. ad libit.
Syrupus Altheæ. E. L.
Amygdalus communis. E.
Amygdal. dulc. et amar. L. D.
Eur. mer. Fructus nucl. et Ol. express.
Emulsio Amygdali communis E.
Lac Amygdalæ. L. D. } ad libit.
Ad Febres. Pneumon. Catarrh., &c.
Oleum Amygdali communis.
Astragalus Tragacantha. E.
Gum Tragacantha. L. D.
Eur. mer. Gummi. Pulv. Solut. ad. libit.
Mucilago Astragali Tragacanthæ. E.
Mucilag. Tragacanthæ. L.
Mucilag. Gum. Tragacanthæ. D.
Pulvis Tragacanthæ comp. L. dr. 1—4.
Avena sativa. E.
Avena. L. D.

Cult. Semen. Decoct. ad libit.
Febres. Pneumon. Catarrh. Dysenter. Diarrhoea., &c.
Cocos Butyracea. E.
Amer. merid. Oleum nucis fixum.
Externe.
Eryngium maritimum. E.
Eryngium. L. D.
Brit. Rad. recens.
Glycyrrhiza glabra. E.
Glycyrrhiza. L. D.
Eur. mer. Rad. Pulv. Decoct. Succ. spissat.
Trochisci Glycyrrhiz. E. L. D. ad libit.
Catarrh., &c.
Hordeum distichon. E.
Hordeum. L. D.
Cult. Semen. Decoct. ad libit.
Ut Avena.
Decoctum Hordei distichi. E. } ad libit.
compositum L. } ad libit.
Lilium candidum.
Lilium album. D.
Cult. Rad. recens. Catapl.
Linum usitatissimum. E.
Linum. L.
Cult. Semen. Infus. Ol. express.
Oleum Lini usitatiss. E. unc. 1—3.
Lini. L. D.
Pneumon. Nephrit. Dysenter. Hæmopt.
Malva sylvestris. E.
Malva. L. D.
Brit. Folia. Decoct.
Decoctum pro Enemate. L.
Melissa officinalis. E.
Melissa. L. D.
Cult. Herba. Infus.
Mimosa nilotica. E.
Gummi Arabicum. L. D.
Arab. Senegal. Gum. Pulv. Solut. ad libit.
Mucilago Mimosæ niloticæ. E. } ad libit.
Arabici Gummi. L. D. } ad libit.
Emulsio Mimos. nilot. E. } ad libit.
Arabica. L. D. } ad libit.
Trochisci Gummosi. E. } ad libit.
Catarrh. Pneumon. Diarrh. Blenorrh.
Pyrus Cydonia. E.
Cydonia Malus. L.
Cult. Semen.
Mucilago Seminis Cydoniæ mali. L.
Sarcocolla.
Asia succ. spissat.
Triticum hibernum. E.
Amylum. L.
Cult. Semen.
Mucilago Amyli. E. D. } ad libit.
Trochisci Amyli. L. } ad libit.
Vitis vinifera. E.
Vitis. L. D.
Fruct. sicc. Uvæ passæ.
Decoct. ad libit.

CLASS X. REFRIGERANTIA.

SECT. I. VEGETABILIA.

Acidum Acetosum dilutum ad libit. extern.
Acetis Potassæ. dr. 2. ad aq. lib. 1 in die.
Aquæ Acetitis Ammoniæ, unc. ½. freq.
Febres. Phlegmas.
Supertartris Potassæ solut. ad libit.
Tamarindus Indica.
Fructus ad libit.
Febres.
Berberis vulgaris.
Berberis. D.
Brit. Fructus.
Febres.
Citrus medica. E.
Limonium. L. D.
Eur. mer. et Ind. Occ. Fruct succ. rec. et crystall.
Syrup. Citri. medic.
Limonii. L. D.
Febres.
Citr. Aurantium. E.
Aurantia. L. D.
Eur. mer. Fruc. succ. recens.
Cochlearia officinalis. E.
Cochlearia. D. C. hortens. L.
Brit. Herba. et succus.
Succ. Cochlear. comp. E. L. ad libit.
Ad Scorbutum.
Morus nigra.
Morus. L.
Cult. Fructus.
Syrupus Fruct. Mori. L.
Oxalis Acetosella.
Lujula. L.
Acetosella. D.
Brit. Herba. Succ.
Conserv. Acetosellæ. D.
Lujulæ. L.
Ribes nigrum. L. D.
Brit. Fruct.
Succ. spissat. Rib. nigr. L.
Syrup. succ. Rib. nigr. L.
Ribes rubrum. L. D.
Brit. Fructus.
Rosa canina. E.
Cynosbatus. L.
Brit. Fruct.
Conserva Rosæ caninæ. E.
Cynosbati. L.
Rubus Idæus. L. D.
Brit. Fructus.
Syrup. Fruct. Rub. Idæi. L. D.

Rumex Acetosa. E.
Acetosa. D.
Acet. pratensis. L.
Brit. Folia.
Sisymbrium Nasturtium. E.
Nasturt. aquatic. L. D.
Brit. Herba.
Ad Scorbutum.
Veronica. Beccabunga.
Beccabunga. L.
Brit. Herba.
Ad Scorbutum.

SECT. II. FOSSILIA.

Zincum.
Sulphas Zinci. Externe pro Lotione.
Nitras Potassæ.
Acid. nitrosum. dr. 1—2. ad Aq. lib. 1. in die.
Febres, &c.
Spirit. ætheris nitrosi. L. E } gtt. 30—
ætthereus nitros. D. } dr. 1.
Trochisci Nitrat. Potass. E.
Nitri. L.
Febres. Phlegmas. Hæmorrh. Maniam.
Murias Sodæ.
Acidum Muriaticum. gtt. 20—40 dilut. subind.
Febres.
Acidum Sulphuricum. E.
Vitriolicum. L. D.
Acidum Sulphuric. dilutum. E. } ut Ac.
vitriolic. dilut. L. D. } Mur.
Febres. Hæmorrhag.
Plumbum. E. L. D.
Acetis Plumbi. E.*
Cerussa Acetata. L. D.
Interne ad Hæmorrhag. sed cautissime.
Aqua Lithargyr. acetati. L. } Externe.
Liquor Litharg. acetat. D. }
Aqua Lithargyr. acetat. comp. L.
Liquor Litharg. Acetat. comp. D.
Unguent. Acetit. Plumb. E.
Cerussæ. acetat. L.
Cerat. Litharg. acetat. comp.
Ad Phlegmasias. &c.

* It is now found that there are two acetates of lead, an acetate which crystallizes in scales, and this salt, which containing an excess of acetic acid should be called superacetas plumbi.

CLASS XI. ASTRINGENTIA.

SECT. I. VEGETABILIA.

Hæmatoxylum campechian. E.
Hæmatoxylum. L. D.
Americ. Lign. Decoct.
Extract. Lign. Hæmat. camp. E. } gr. 10—30.
Hæmatoxyl. L.D. }
Juglans regia.
Juglans. L.
Brit. Fruct. immatur. Decoct. Externe. Ulcera.
Kino. E. L. D.
Africa Pulv. Solut. gr. 15—30.
Tinct. Kino. E. D. dr. 1—2.
Diarrh. Dysent. Menorrh.
Mimosa Catechu. E.
Catechu. L. D.
India. Extract. lign. Pulv. Solut. scr. 1—2.
Infus. Mimos. Catechu. E. unc. ½—1½.
Tinct. Mimos. Catechu. E. } dr. 1—3.
Catechu. L. }
Elect. Catechu. E. } scr. 2—4.
Comp. D. }
Diarrh. Dysenter.
Anchusa. Tinctoria. E.
Anchusa. D.
Eur. Merid. Radix.
Boletus igniarius. E.
Agaricus.
Brit. ad vulnera.
Pterocarpus Santolinum. E.
Santolinum rubrum. L. D.
India Lign.
Polygonum Bistorta.
Bistorta. L. D.
Brit. Rad. Pulv. dr. ½—1. Decoct.
Potentilla reptans.
Pentaphyllum. L.
Brit. Fol.
Prunus Spinosa.
Prun. sylvestris. L.
Brit. Fruct. ad libit.
Conserv. Prun. sylvestris. L. dr. 1—3.
Diarrh.
Pterocarpus Draco. E.
Sanguis Draconis. L. D.
Amer. merid. Resina.
Punica granatum.
Granatum. L.
Flor. Balaust. D.
Eur. Merid. Flor. Cort. Fruct.
Decoct. ad Gargar. ad libit.
Quercus cerris. E.
Gallæ. L. D.
Asia. Cyniphis nidus. Pulv. Inf. Ungt.
Quercus robur. E.
Quercus. L. D.
Brit. Cort. Decoct. Externe.
Scarlatin. Angin.—Uvulæ relaxat.
Hæmorrh. Menorrhag.
Rosa Gallica. E.
Ros. Rubr. L. D.

Eur. Merid. Brit. Petal. Inf. Conserv. ad libit.
Inf. Ros. Gallic. E. } ad libit.
Rosæ. L.
Rosar. D.
Conserv. Ros. gallica. E.
Rosæ. D.
Ros. rubr. L.
Syrup. Ros. Gall. E.
Mel. Ros. L. D.
Hæmorrh. Cynanchen, &c.
Tormentilla erecta. E.
Tormentilla. L. D.
Brit. Rad. Decoct. unc. ½—1.
Diarrhœa.

SECT. II. FOSSILIA.

Sulphas Cupri. gr. ½—1. bis turve in die.
Febr. Intermitt.
Inject. Lot. Collyr.
Solut. Sulphat. Cupri. E.
Liquor Cupri Ammoniat. D.
Aq. Cupri. Ammon. L.
Ophthalm. Gonorrhœa.
Zincum.
Sulphas Zinci. gr. 2—5. bis terve in die.
Febres Intermitt.
Solutio Acetit. Zinci. Collyr. Inject.
Aqua Zinciæ Vitriolat. cum Camphora. L.
Ohpthalm. Blenorrh.
Ferrum.
Tinctura Muriat. Ferri. gtt. 10—20. ter in die.
Menorrhag. cum debilitate.
Plumbum.
Acetis Plumbi. Lotion.
Oxydum album et Semivitreum.
Super-Sulphas Alumin. et Potass.
Sulphas Alumin. E.
Alumen. L. D.
Brit. Pulv. Solut. gr. 5—15.
Externe p. Gargar. et Lotione.
Sulphas Alumin. exsiccat. E.
Alumen ustum. L.
Pulvis Sulphat. Alumin. comp. E. gr. 15—30.
Cataplasm. Aluminis. L.
Ophthalm.
Aqua Alumin. comp. L. pro Lotione.

CLASS XII. TONICA.

SECT. I. VEGETABILIA.

Anthemis Nobilis. Pulv. gr. 10—scr. 1. Infus. unc. ½. ad lib. 1.
Centaureæ benedicta. Infus.
Marrubium Vulgare. Infus.
Myrrha. Pulv. Pil. gr. 10—20.
Pulv. Myrrh. Comp. gr. 20. ad 30.
Dorstenia Contrajerva. Pulv.
Pulv. Contrajerv. Comp. L. gr. 20—30.
Vitis Vinifera.
Vinum rubrum Lusitanum.
Æsculus Hippocastanum. E.
Asia. Brit. Cort. Pulv. dr. ½—scr. 2.
Decoct. unc. 1. ad lib. 1.
Angustura. E. L. D.
Ind. Occident. Cort. Pulv. gr. 15—dr. ½.
Inf.
Chironea. Centaur. Gentian. Cent. E.
Centaur. Min. D.
Brit. Summitat. Infus.
Cinchona officinalis. E.
Cinchona. L.
Cort. Peruv. D.
Peru. Cort. Pulv. dr. ½—2. Electuar.
Enem. dr. 1—3.
Inf. Cinchon. Off. E. } unc. 2—4.
Cort. Peruv.
Decoct Cinchon. Off. } unc. 3—6.
Cort. Peruv.
Tinct. Cinchon. Off. E. L. D unc. ½—1.
Comp. L. D. dr. 3—6.
Ammoniat. dr. ½—1.
Extract Cinchon. Off. E. } gr. 10—20.
Cort. Peruv. L. D.
Ad Febres. Rheumatism. Odontalg.
Catarrh. Febril. Blenorrh. Dysenter.
Erysipelat. Scarlatin. Hæmoptys.
Menorrhag. Dyspeps. Hypochond.
Astheniam. Spasmos. Hydrop.
Cinchona Carribbæ.
Insul. Caribb. Cort. (ut Cinchon Off.)
Columba. L. E. D.
Ceylon. Africa. Rad. Pulv. gr. 5—20.
Inf. dr. 3. ad lib. 1.
Tinct. Columbæ. L. D. E.
Croton Eleutheria. E.
Cascarilla. L. D.
Ind. Or. et Occident. Cort. Pulv. scr. 1—dr. 1.
Tinct. Cascarill. L. D. dr. 2—6.
Extract. Cascarill. L. D. gr. 10—20.
Gentiana lutæ. E.
Gentiana. L. D.
Eur. Merid. Rad.
Inf. Gentian. Comp. E. unc. ½—1.
D. dr. 6—12.
L. unc. 2—4.
Tinct. Gentian. Comp. E. L. dr. 2—6.
Vin. Gent. Comp. E. unc. 1—2.
Extract. Gent. L. D. lut. E. gr. 10—30.
Menyanthes Trifoliata. E.
Trifol. Paludos. L.
Brit. Rad. Exsiccat. Inf. unc. ½—lib. 1.
Quassia Excelsa. E.
Quassia. L.

Insul. Caribb. Lignum. Cort. Rad. Inf. dr. ½—2. ad lib. 1.
Qu. Simaruba. E.
Simarouba. L. D.
Ind. Occ. Cortex. Decoct. dr. 2. ad lib. 1.
Salix fragilis.
Salix. D.
Brit. Cortex. Pulv. scr. 2—4.
Decoct. unc. 2. ad lib.
Swietenia Mahagani. E.
Ind. Occ. Cortex. Pulv. Decoct. ut Cinchona.
Sw. Febrifuga. E.
Ind. Occ. Cort. ut supra.
Tanacetum. vulgare.
Tanacetum. L. D.
Brit. Fol. Flor. Infus.
Ad Vermes.

SECT. II. FOSSILIA.

Sulphas Cupri. gr. 1—3. bis terve in die.
Febr. Intermitt.
Ammoniaretum Cupri. E. } gr. ½
Cuprum Ammoniatum. L. }
bis terve in die.
Pilulæ Ammoniar. Cupri. E. Pil. 1.
Epileps.
Zincum.
Sulphas. Zinci. gr. 2—5. bis terve in die.
Febr. Intermitt. Epileps.
Solutio Sulphat. Zinc. E.
Externe pro Collyrio.
Oxydum Zinci. E.
Zincum calcinatum. L. } gr. 1. bis terve
Calx Zinci. D. } in die.
Epileps.
Nitras Potassæ.
Acidum Nitrosum. gtt. 30—40.
Sulphas Magnesiæ. Solut. dr. 2. bis in die.
Ferrum.
Carbonas Ferri scr. 1—dr. 1.
Præcip. gr. 5—15.
Aq. Ferri ærati. D. lib. ½. bis in die.
Sulphas Ferri. gr. 1—5.
Vinum Ferri. dr. 2—6. bis in die.
Tinct. Muriat. Ferri. gt. 10—30. bis in die.
Sulphas Ferri exsiccat. E.
Oxydum Ferri rubrum. E.
Emplast. Oxcid. Ferri rub. E.
Ferri limatura purific. E.
Oxydum Ferri nigr. purific. E.
Murias Ammon. et Ferri. E. } gr.
Ferrum Ammoniacale. L. } 3—10.
Tinct. Ferr. Ammoniac. L. gtt. 10—30.
Tartris Ferri et Potassæ. E. } gr.
Ferrum Tartarisatum. L. } 10—30.

Tinct. Ferri acetati. D. gtt. 20—40.
Dyspeps. Hypochondrias. Asthen. Chorcam. Hydrop. Chloros. Phthis. Vermes.
Acidum Sulphuricum.
Acidum Sulphur. dilutum. gtt. 20—40.
Acidum Sulphuric. Aromaticum E. gtt. 10—20. bis terve in die.
Dyspeps, &c.
Argentum. L. E. D.
Nitras Argenti. E. } gr. ¼—½.
Argentum Nitratum. L. D. } bis in die.
Arsenicum. Oxid. alb. vel. Acid. Arsen.
Oxidum Arsenici. E.
Solut.
Carbonas Barytæ. E.
Vid. Sulphas Barytæ.
Carbonas Calcis. E.
Creta. L. D.
Brit. &c.
Solutio Muriatis Calcis. E. gt. 30—60, bis terve in die.
Ad Scrofulam, Schirrum, &c.
Sulphas Barytæ.
Terra ponderosa.
Brit.
Murias Barytæ. E.
Solutio Muriatis Barytæ. E. gt. 5—10. bis terve in die.
Ad Scrofulam, Schirrum, &c.

CLASS XIII. STIMULANTIA.

SECT. I. ANIMALIA.

Murias Ammoniæ.
Aqua Ammoniæ. E. gt. 10—20. pur. L.
Liquor. alkal. volat. caust. D.
Alcohol Ammoniatum. E. gt. 20—40.
Spiritus Ammoniæ. L.
Alkal. volat. D.
Carbonas Ammoniæ, E. gr. 5—10.
Ammonia præparata. L.
Alkali volatile mite. D.
Aqua Carbonat. Ammon. E. gt. 20—dr. 1.
Ammoniæ. L.
Liq. alkal. volatil. mit. D.
Liq. volat. Cornu Cervi, L. gt. 20—dr. 1.
Sal. Cornu Cervi, L. gr. 10—20.
Oleum Ammoniatum, E.
Liniment. Ammon. fort. L.
Liniment. Ammon. L.
Liniment. volatile. D.
Alcohol. Ammoniat. aromaticum. E, gt. 20—dr. 1.
Spir. Ammon. comp. L.
Alcoh. volat. arom. D.
Spir. Ammon. succin. L.

Asphyx. Spasmos. Rheumatism, &c.
Moschus moschiferus.
Bol. Mist. gr. 10—scr. 1.
Mistura Moschata. unc. 1—2.
Ad Typhum. Gangraen.
Coccus Cacti. E.
Coccinella. L.
Mexico.
Lytta vesicatoria.
Bol. gr. 1—3.
Tinct. Meloes vesicat. gt. 10—30.
Ungt. Infus. mel. vesicat. E.
Cantharid. L. D.
Pulv. mel. vesicat. E.
Ceratum. Cantharid. L.
Empl. melo. vesicat. E.
Cantharidis L. D.
mel. vesicat. com. E.
Ad Synoch. Typh. Phrenit. Cynanch. Pneumon. Gastrit. Enterit. Rheumatism. Odontalg. Variol. Scarlatin. Apoplex. Paralys. Chorcam. Asthm. Dyspnœam. Pertuss. Colicam. Hysteriam. Hydrophob. Maniam. Icterum. Caligin. Amauros. Ischuriam.

SECT. II. VEGETABILIA.

Sinapis alba.
Semen et ejusd. Pulvis. dr. 1—4.
Cataplasma Sinapeos. L. D.
Rheumatism. Paralys.
Allium sativum.
Rad. recens.
Arum maculatum.
Rad. recens. Bol. Elect. Emuls. gr. 10—20. bis in die.
Conserva Ari. L. dr. ½—dr. 1.
Rheumatism.
Pimpinella Anisum.
Semen.
Ol. volat. Pimpin. Anisi. gtt. 2—6.
Dyspeps. &c.
Styrax Benzoin.
Balsamum.
Acidum Benzoicum. gr. 1—3.
Tinctura. Benzoes comp. L. gtt. 10—20.
Alcohol.
Æther Sulphuricus. dr. ½—dr. 1.
Ad. Morb. spasmod.
Æther Sulphuric. cum Alcohole. E.
Spiritus Ætheris vitriolici. L. / Liquor æthereus vitriolicus. D. } gtt. 15—30.
Æther Sulphur. cum Alcohol. comp. E. / Spir. æther. vitriol. comp. L. } gtt. 15—30.
Oleum Vini. L. gtt. 10—20.

Acidum Acetosum.
Acidum Acetosum forte. E.
Externe per nares in Syncope, Asphyxia, &c.
Acidum Acetosum Camphoratum E.
Ut supra.
Acetum Aromaticum. E.
Ut supra.
Aristolochia Serpentaria.
Rad. Pulv. Bol. scr. 1—2.
Tinctura Aristol. Serpentar. dr. 2—6.
Typh. Dyspeps.
Daphne Mezereum.
Rad.
Decoctum Daphn. Mezerei. unc. 1—2 sæp. in die.
Ad morbos cutan. Syphil.
Guaiacum officinale.
Lign. Decoct. unct. 1. ad lib. 1. Resin Pulv. Emuls. gr. 10—20.
Rheumatism. Syphil. Morb. cutan.
Decoctum Guaiac. officin. unc. 4—8. bis in die.
Tinctura Guaiac. offic. dr. 2—4.
ammoniat. dr. 1—3.
Papaver somniferum.
Opium. gr. ½—1. dos. repetit.
Tinctura Opii gtt. 5—20. simili modo.
Camphorat. dr. 1—4.
Ammoniat. dr. ½—1.
Typh. Dyspeps, Tetan. &c.
Cochlearia Armoracia.
Rad. rec. Subst. Infus.
Spirit Raphani comp. L. unc. 1—2.
Paralys. &c.
Copaifera officinalis.
Balsam. gtt. 15—30.
Pinus { Sylvestris. / Larix.
Ol. vol. Pini puriss.
Ungt. Resin. flav. L. D.
Resinosum. E.
Cerat. Resin. flav. L.
Empl. Ceræ. D. comp. L.
Ungt. Picis. L. D.
Empl. Picis. Burgund.
Externe ad Ulcera. &c.
Arnica montana.
Rad. Pulv. scr. 1—2.
Typh. Paralys.
Bubon Galbanum.
Pilul. Galbani comp. gr. 15—20.
Emplastrum Galbani comp. E.
Lithargyri compos. L.
Juniperus Sabina.
Oleum Juniper. Sabinæ, gt. 1—4.
Pastinaca Opoponax.
Pil. gr. 2—5.
Veratrum album.
Unguentum Hellebori albi. L.

Decoct. Hellebori albi. L.
Ad morb. cutan. L.
Amomum Zingiber.
Rad. Pulv. gr. 5—20.
Podagr. retroced. vel atonic. Paralys. Dyspeps, &c.
Syrupus Amom. Zingib.
Tinctura Amom. Zingib. E. dr. 2—4.
Acorus Calamus. E.
Calamus aromaticus. L.
Brit. Rad. Pulv.
Amomum repens. E.
Cardamomum minus. L. D.
India. Semen.
Tinctura Amomi repent. E. } dr. 2—4.
Cardamomi. L. D. }
comp. L. dr. 2—4.
Amyris Gileadensis.
Asia. Resina.
Amyris Elemifera.
Elemi. L. D.
Amer. mer. Resina.
Unguentum Elemi. L.
Anethum Fœniculum. E.
Fœniculum. L. D.
Brit. Sem. Decoct. Enem.
Oleum volatil. Fœnicul. dulc. D.
Aqua Fœniculi dulcis. L. unc. 1—3.
Anethum graveolens.
Eur. mer. Semen.
Aqua Anethi. L.
Angelica Archangelica. E.
Angelica. L. D.
Cult. Rad. Semen.
Apium Petroselinum. E.
Petroselinum. L.
Cult. Rad. Semen.
Arbutus Uva Ursi. E.
Uva Ursi. L. D.
Eur. merid. Folia. Pulv. scr. 1—dr. 1. Infus.
Ad Calculum.
Artemisia maritima.
Absinthium maritimum. L.
Brit. Cacumen.
Conserva Absinthii maritimi. L.
Decoctum pro Fomento. L.
Canella alba. E. L. D.
India Occid. Cortex. Pulv.
Carbo Ligni.
Delphinium Staphisagria.
Staphisagria. L. D.
Eur. Mar. Sem. Pulv.
Capsicum annuum.
Piper Indicum. L. D.
Ind. Occ. Capsulæ. Pulv. gr. 2—6. Infus.
Ad Febres. Scarlatinam anginosam.
Carum Carvi. E.
Carum. L.
Carvi. D.
Cult. Semen. Decoct.
Oleum Carvi. L. gtt. 1—4.
Spiritus Cari Carvi. E. } unc. ½—2.
Carvi. L. D. }
Dyspeps. Colic.
Cistus Creticus.
Ladanum. L.
Syria. Resina.
Emplastrum Ladani compos. L.
Citrus Aurantium.
Aurantium Hispalense. L. D.
Eur. merid. Flores. Cortex. Fruct. Infus.
Oleum volat. Citri Aurant. E. gtt. 2—6.
Aqua Citri Aurantii. E. unc. 1—3.
Tinctura Aurantii Cort. L. D. unc. ½—1½.
Syrupus Citri Aurantii. E.
Cort. Aurantii. L. D.
Conserva Citri Aurantii. E.
Cort. Aurantii. L. D.
Coriandrum sativum. E.
Coriandrum. L. D.
Eur. merid. Semen. Pulv. Infus.
Crocus sativus. E.
Crocus. L. D.
Cult. Stigmata. Infus.
Syrupus Croci. L.
Tinctura Croci. E. L. dr. 2—4.
Cuminum Cyminum.
Cuminum. L.
Ægypt. Sicil. Semen. Decoct.
Cataplasma Cumini. L.
Emplastrum Cumini. L.
Curcuma longa.
Curcuma. L.
India. Radix. Pulv.
Daucus Carota. E.
Daucus Sylvestris. L.
Brit. Semen. Radix. Cataplasm.
Dianthus Caryophyllus. E.
Caryophyllum rubrum. L. D.
Italia. Petala. Infus.
Syrupus Caryophylli rubri. L.
Eugenia caryophyllata. E.
Caryophyllum aromaticum. L. D.
Insul. Molucc. Floris germen.
Oleum volat. Caryophylli aromatici. gtt. 1—2.
Odontalg. Colic.
Hypericum perforatum.
Hypericum. L.
Brit. Flos.
Inula Helenium.
Enula campana. L. D.
Brit. Radix.
Juniperus Lycia. E.
Olibanum. L. D.

Asia. Gum-resin. Pilul.
Kaempferia rotunda. E.
Zedoaria. L.
India. Rad. Pulv.
Lavandula Spica. E.
Lavendula. L.
Lavandula. D.
Cult. Flores.
Oleum volat. Lavandulæ Spicæ. E.
Lavendulæ. L.
Spiritus Lavandulæ Spicæ. E.
Lavendulæ. L.
Spiritus Lavandulæ comp. E. } dr. ½—1.
Tinctura Lavendulæ comp. L. }
Laurus Cinnamomum. E.
Cinnamomum. L. D.
Ceylon. Cortex. Pulv. gr. 5—15. Infus.
Ol. volat. Laur. Cinnamom. } gt. 1—2.
L. essent. Cinnamom. D. }
Aqua Laur. Cinnam. E. unc. 1—3.
Cinnamom. L. D.
Spir. Laur. Cinnamom. E. unc. ½—1½.
Cinnamom. L. D.
Tinct. Laur. Cinnamom. E. dr. 2—4.
Cinnamom. L. D.
Cinnamom. comp. E. dr. 1—2.
Cinnam. comp. L. D.
Pulv. Aromaticus. L. E. D. gr. 10—20.
Electuar. Aromat. E. D. gr. 10—30.
Confect. Aromat. L.
Laurus Cassia. E.
Cassia lignea. D.
India. Cortex. Pulv. &c. Flor. nondum. explicit.
Aqua Lauri Cassiæ. E. unc. 2—4.
Laurus nobilis. E.
Laurus. L. D.
Cult. Folia. Bacc. et Oleum Bacc. Externe.
Lobelia syphilitica. E.
Virgin. Rad. Pulv.
Ad Siphilidem.
Melaleuca Leucodendron. E.
Cajeputa.
Insul. Molucc. Ol. essential. gtt. 1—4. et Externe.
Rheumatism.
Mentha viridis. E.
Mentha sativa. L. D.
Cult. Herba. Infus.
Oleum Menthæ sativæ. L. gtt. 2—6.
Aqua Menthæ sativæ. L. D. unc. 2—6.
Spiritus Menthæ sativæ. L. unc. 1—2.
Colic.
Mentha Piperita. E.
M. Piperitis. L. D.
Cult. Herba. Inf.
Aq. Menthæ piperitæ. E. unc. 1—4.
piperitidis. L. D.
Ol. volat. Menthæ piper. E. gt. 1—3.
essent. M. piperitid. L. D.
Spir. Menthæ piperit. E. dr. 2—6.
piperitid. L. D.
Mentha Pulegium. E.
Pulegium. L. D.
Cult. Herba. Infus.
Aq. Menth. Pulegii. E. unc. 2—4.
Pulegii. L. D.
Ol. volat. Menth. Puleg. E. gt. 1—3.
essent. Pulegii. L. D.
Spirit. Pulegii. L. unc. 1—2.
Myristica Moschata. E.
Myristica. L.
Nux Moschata. D.
Insul. Molucc. Nucleus. Pulv. Ol. volatil. et express. gtt. 1—3.
Spiritus Myristic. Moschat. E. } dr. 2—6.
Nucis moschatæ. L. D. }
Myroxylon Peruiferum. E.
Balsamum Peruvianum. L. D.
Amer. merid. Balsam. gtt. 10—30.
Tinctura Balsami Peruviani. dr. 1—2.
Myrtus Pimenta. E.
Pimento. L. D.
Jamaica. Bacca.
Aq. Myrti Piment. E. unc. 2—6.
Piment. L.
Ol. volat. Myrt. Pim. E. gt. 1—3.
Spir. Myrt. Piment. E. unc. 1—2.
Pimento. L. D.
Origanum vulgare. E.
Origanum. L. D.
Brit. Herba.
Oleum Origani. L.
Ad Odontalg.
Panax quinquefolium.
Ginseng. L.
China. Radix. Pulv.
Parietaria officinalis.
Parietaria. L.
Brit. herba.
Pinus balsamea. E.
Balsamum Canadense.
Americ. septent. Resina liquida.
Piper nigrum. E. L. D.
India. Fruct.
Piper Cubeba.
Cubeba. L.
Java. Fruct.
Pip. longum. E. L. D.
Fruct.
Pistacia Terebinthus.
Terebinthina Chio. L.
Insul. Chio. et Cyprus.
Rhus Toxicodendron E.

Amer. Folia Pulv. gr. ½—bis terve in die.
In Paralysin.
Styrax officinale. E.
Styrax. L. D.
Eur. merid. Balsam.
Styrax purificata. L. D.
Toluifera Balsamum. E.
Balsamum Tolutanum. L. D.
Amer. merid. Balsam. Troch.
Tinctura Toluiferæ Balsam. E.
Syrupus Toluiferæ Balsam. E.
Tolutan. L.
Trigonella Fœnum græcum.
Fænum græcum. L.
Gallia. Semen. Catapl. Fotus.
Urtica dioica.
Urtica. L.
Brit. Herb. rec. Externe. Pulv. scr. 1—dr. 1.
Paralys. Febr. Intermitt.
Wintera aromatica. E.
Amer. merid. Cortex. Pulv.

SECT. III. FOSSILIA.

Hydrargyrum.
Vid. Sialagoga.
Ungt. Oxid. Hydr. rubr. E.
Nitrat. Hydrarg. E.
Hydrarg. nitrat. L.
Un. nitrat. Hydrarg. mitius. E.
Nitras Potassæ.
Acidum nitrosum. dr. 1—in die.
Unguentum Acidi nitrosi. E.
Ad morb. cutan.
Sapo Hispanus.
Tinctura Saponis. E.
Linimentum Saponis compos. L.
Saponaceum. D.
Rheumatism, &c.
Tinctura Saponis cum Opio. E.
Ceratum Saponis. L. D.
Emplastrum Saponis. L.
Saponaceum. E. D.
Murias Sodæ
Murias Sodæ exsiccatus. E.
Externe in Asphyx.
Acidum Sulphuricum.
Externe in Ungt. ad morb. cutan. et interne.
Oxidum Arsenici.
Externe in Carcinom.
Bitumen Petroleum. E.
Petroleum. L.
India.
Oleum Petrolei.
Sub-boras Sodæ.
Boras Sodæ. E.
Borax. L. D.
India Pulv. Linctus.
Ad Aphthas.
Sub-acetis Cupri. E.
Ærugo. L. D.
Collyr. Ungt.
Oxymel Æruginis. L.
Unguentum Sub. acetit. Cupri. E.
Calx. E.
Calx viva. L. D.
Linimentum Aquæ Calcis. E.
Ad Tineam Capitis.
Nitras argenti.
Externe pro escharchio.

CLASS XIV. ANTISPASMODICA.

SECT. I. ANIMALIA.

Murias Ammoniæ.
Vid. Stimulantia.
Moschus moschiferus.
Pulv. Bol. scr. 1—dr. ½.
Cervus Elaphus.
Ol. Animal. L. } gtt. 15
Cornu Cervin. rectificat. D. } —30.
Castor Fiber. Pulv.
Tinctur. Castor. gtt. 30—dr. 1.
compos. gtt. 20—40.
Ad Hysteriam, &c.

SECT. II. VEGETABILIA.

Cephælis Ipecacuanha.
Pulv. gr. 3—6.
Nicotiana Tabacum.
Fum.
Colic.
Ferula Asa fœtida.
Pilul. gr. 10—scr. 1.
Alcohol Ammoniat. fœtid. E. }
Spiritus Ammoniæ fœtid. L. } gtt. 15-30.
Spt. Alkali. volatil. fœtid. D. }
Pilulæ Asæ fœtid. comp. E.
Emplastr. Asæ fœtid. E.
Hysteria, &c.
Alcohol.
Æther Sulphuricus. dr. ½—2.
Laurus Camphora.
Emulsio Camphorata, unc. 2—3.
Mistura Camphorata, unc. 2—3.
Tinctura Camphoræ. E.
Spirit. Camphoratus. L. D. Externe.
Liniment. Camphor. com. L.
Camphorat. D.
Papaver somniferum.
Opium. Pil. Mist. gr. 1—
Liniment. Enem.
Tinct. Opii.
camphorat. L. dr. 1—4.
ammoniata. E. dr. 1.

Elect. Opiatum. gr. 5.
Pilul. Opii. L.
Opiatæ. gr. 10.
Bubon Galbanum.
Pilul.
Tinctura Galbani. L. dr. 1—2.
Pilul. Galbani comp. L. gr. 15—40.
Hysteria.
Vitis vinifera.
Vinum rubrum Lusitanum. lb. 1—in die.
Ad Tetanum.
Citrus Aurantium.
Fol. Pulv. dr. ½.
Convuls.
Artemisia Absinthium.
Absinthium vulgare. L.
Brit. Cacumen. Oleum. volat.
Carbonas Potassæ impurus. E.
Cineres clavellati. L. D.
Aqua Potassæ. E.
Kali puri. L.
Lixivium alkali vegetab. caust. D.
Externe in Balneo ad Tetanum.
Cardamine pratensis. E.
Cardamine. L.
Brit. Flores. Pulv. dr. ½. bis in die.
Ad Choream, &c.
Conium maculatum. E.
Cicuta. L. D.
Brit. Folia. Pulv. gr. 1.
Succus spissat. Conii maculat. E.
Extract. Cicutæ. L. D.
Fuligo Ligni Combusti. D.
Hyster.
Hyoscyamus niger. E.
Hyoscyamus. D.
Brit. Folia. Semen.
Succus spissat. Hyoscyam. nigri. E. gr. 2—4.
Valeriana officinalis. E.
Valeriana. L. D.
Brit. Radix. Pulv. scr. 1—dr. 1—bis terve in die.
Tinctura Valerianæ. L. dr. 2—4.
Ammoniat. E. dr. 1.
Extract. Valerian. sylvestr. resinos. D.
Ad Hysteriam, &c.

SECT. III. FOSSILIA.

Hydrargyrum.
Vid. Sialagoga.
Bitumen Petroleum. E.
Petroleum. L. D.
Italia.
Oleum Petrolei. L.
Succinum. L. E. D.
Oleum Succini. E.
purissimum. E. } gtt. 10
rectificat. L. D. } —20.
Sal Succini. D.
Spiritus Ammoniæ. succinat. L. gtt. 30.

CLASS XV. NARCOTICA.

VEGETABILIA.

Nicotiana Tabacum.
Vinum Nicot. Tabaci. E. gt. 30. dr. 1 bis in die.
Aconitum neomontanum.
Succus spissat. Aconit. napel gr. ½—2.
Papaver somniferum.
Tinct. Opii. gt. 25.
Camphorat. dr. 2—6.
Syrup. Opii. D.
Extr. Papaver. somnifer. E.
Pulv. Opiat. L. E. gr. 10.
Elect. Opiatum. E. gr. 43.
Confect Opiata. L. gr. 36.
Pil. Opii. E. gr. 5.
Opiatæ. E. gr. 10.
Ad Febr. intermittent. Typh. Rheumatism. Odontalg. Catarrh. Dysenter. Ophthalm. Enterit. Scarlatin. Variol. Rubeol. Hæmoptys. Menorrhag. Hæmorrh. Tetan. Choream. Epileps. Pertuss. Asthmat. Hydrophob. Angin. pectoris. Hysteriam. Phthis. Icter. Diabet.
Rhododendron Chrysanthum.
Folia. Vid. Diaphoretica.
Digitalis purpurea.
Pulv. gr. 1.
Tinctura Digital. purpur. gtt. 10—
Ad Synocham. Phrenit. idiopath et Hydrocephalic. Pneumon. Phthisin, &c.
Arnica montana.
Flores. Pulv. gr. 5.
Paralys. Convuls. Amauros.
Rhus Toxicodendron.
Folea. Vid. Stimulantia.
Conium maculatum.
Pil. Pulv. gr. 1.
Succus spissat. Conii maculat. gr. 2.
Hyoscyamus niger.
Succus spissat. Hyoscyam. nigr. gr. 2—4.
Tinctura Hyoscyami nigr. E. dr. 1.
Atropa Belladonna. L. D.
Belladonna. L. D.
Brit. Fol. Pulv. gr. 1.
Datura Stramonium. E.
Brit. Fol. Pulv. gr, 1.
Humulus Lupulus*.

* We have inserted the hop among the articles of the materia medica, as it probably would have been received by the Edin-

Cult. Conus. Pulv. Pil. gr. 3.
Lactuca viroso. E.
Brit. Folia. Succ. spissat. gr. 1.
Ad Hydrop.
Papaver Rhœas. E.
Papaver erraticum. L.
Brit. Petala. Infus.
Syrupus Papaver. errat. L.
Sium nodiflorum.
Sium. L.
Brit. Herba.

CLASS XVI. ANTHELMINTICA.

SECT. I. ANIMALIA.

Murias Ammoniæ.
Aqua Carbonatis Ammoniæ.
Emuls.

SECT. II. VEGETABILIA.

Anthemis nobilis.
Pulv. scr. 1.—dr. ½—bis in die.
Lumbric.
Nicotiana Tabacum.
Enema.
Ascarid.
Olea Europea.
Oleum. Enema. Emuls.
Allium sativum.
Rad. recens. Subst. ad libitum.
Ferula Asa fœtida.
Gum. Resin. Enema. scr. 1—2.
Convolvulus Jalapa.
Rad. Pulv. gr. 10—30.
Convolvulus Scammonium.
Pulv.
Pulvis Scammonii compositus.
Helleborus fœtidus.
Fol. Succ. express.
Lumbric.
Rheum palmatum.
Pulv. gr. 5—10. omni nocte.
Ricinus communis.
Oleum express. unc. ½—1. Enem. unc. 1—2.

burgh College, had their Pharmacopeia been published some months later. Within the last year it has been frequently employed in the Edinburgh Infirmary as a substitute for opium with great success, as it was found to produce sleep in cases where opium was ineffectual or inadmissible. It is usually administered in the form of a saturated tincture.—Vid. De Roches' "Dissert. Inaug. de Humulo Lupulo. Edin. 1803."

Dr. Spens has adopted it in his edition of the Infirmary Pharmacopoeia, and has given a formula of it under the title of "Pilulæ Humuli lupuli."

Stalagmitis Cambogioides.
Pil. gr. 5—15.
Ad Tæniam.
Ruta graveolens.
Infus. Enema.
Oleum volat. Rutæ. gtt. 3—6.
Juglans regia.
Cortex Fructus immatur. Extract.
Tanacetum vulgare.
Flor. Pulv. scr. 1—2.
Valeriana officinalis.
Rad. Pulv. dr. 1.
Artemisia Santonica. E.
Santonicum. L. D.
Asia. Semen. Pulv. dr. ½.—scr. 2. bis in die.
Dolichos pruriens. E.
Ind. Occ. Pubes leguminum. Elect gr. 10—30.
Geoffrœa inermis. E.
Jamaica. Cortex. Decoct. Syrup.
Decoctum Geoffr. inerm. E. unc. 1—2. omni mane.
Polypodium Filix mas. E.
Filix. L.
Filix mas. D.
Brit. Rad. Pulv. dr. 2—3.
Ad Tæniam.
Spigelia marilandica. E.
Amer. Rad. Pulv. gr. 10—scr. 2.

SECT III. FOSSILIA.

Hydrargyrum.
Amalgama Stanni.
Submurias Hydrargyri. gr. 3—10.
Murias Sodæ.
Pulv. dr. ½—unc. 1.
Ferrum.
Carbonas Ferri gr. 10—30.
Sulphas Ferri gr. 3—10.
Ferri limatura purificat. dr. ½—1.
Tartris Ferri et Potassæ gr. 10—scr. 1.
Calx. E.
Calx viva. L.
Calx recens usta. D.
Aqua Calcis. L. E. D. Enema. lib. ½—1.
Ad Ascard.
Stannum L. E. D.
Stanni Pulvis. L. unc. ½—1.
Ad Tæniam, et Lumbric.

CLASS XVII. ABSORBENTIA.

SECT. I. ANIMALIA.

Cervus Elaphus.
Phosphas Calcis. E. } gr. 10—20
Cornu Cervi ustum ppt. L. } bis in die.
Ad Rachit.
Cancer Astagus et Pagurus. E.

Cancris oculi, vel Chelæ. L.
Brit. Lapil. et Chelæ. Pulv.
Chelæ. Cancr. ppt. L. dr. ½—1.
Pulv. e Chel. Cancr. Comp. L. scr. 1—2.
Ad Diarrhœam, &c.
Murias Ammoniæ.
Aq. Ammoniæ. gtt. 10—15.
Carbonas Ammoniæ. gr. 5—15.
Aq. Carbonatis Ammon. gtt. 20—40.
Sal. Cornu Cervi. gr. 5—12.
Ad Cardialg, &c.
Isis nobilis. E.
Corallium. L.
Corallium rubrum præpar. L.
Ostrea edulis. E.
Ostreæ Testeæ. L.
Brit. Testæ Pulv.
Testæ Ostr. præpar. L.
Spongia officinalis. E.
Spongia. L.
Spongia usta. L. scr. 1—2.
Ad Scroful.

SECT. II. VEGETABILIA.

Carbonas Potassæ impurus.
Aqua Potassæ.
Potassa. E. Externe.
Kali purum. L.
Alkali vegetabile caust. D.
Potassa cum Calce. E.
Calx cum Kali puro. L.
Causticum mitius. D.
Carbonas Potassæ. E. gr. 10.
Kali præparatum. L.
Alkali vegetabile mite.
Carbonas Potass. puriss. E. gr. 10.
Aqua Carbonat. Potass. gt. 30.
Kali. L.
Lixivium mite. D.
Aqua super-carbonat. Potass. E. unc. 4. sæp. in die.
Liquor Alkal. veget. mitiss. D.
Ad Cardialg. Calculum, &c.

SECT. III. FOSSILIA.

Sulphur sublimatum.
Sulphuretum Potassæ. E. } gr. 10.
Kali sulphuratum. L. } gr. 10.
Alkali vegetabile sulphurat. D. } gr. 10.
Ad Venena metallica.
Hydrosulphuretum Ammoniæ. E. gtt. 5—10.
Ad Diabeten.
Sulphas Magnesiæ.
Carbonas Magnesiæ. dr. ½.
Magnesia Alba. L. D.
Magnesia. E. scr. 1—dr. 1.
Magnesia Usta. L. D.
Trochisci Magnesiæ. L. ad libit.
Ad Cardialgiam.
Calx.
Aqua Calcis. E. L. D.
Ad Dyspeps.
Bolus Gallicus. L.
Pulv.
Ad Diarrhœam, &c.
Carbonas Calcis. E.
Creta. L. D.
Carbonas Calcis præparat. E. gr. 15—dr. 1.
Creta præparata. L. D.
Pulv. Carbonat. Calc. com. E. gr. 15—30.
Cretæ composit. L.
Trochisc. Carbonat. Cretæ. E. ad libit.
Cretæ. L.
Potio Carbonat. Calcis. unc. 2—3.
Mistura Cretacea. L.
Aqua Æris fixi. D. lib. ½—1 in die.
Ad Cardialgiam. Calculum.
Carbonas Sodæ impurus. E.
Natron. L.
Alkali fossile mite. D.
Carbonas Sodæ. E. } gr. 10—30.
Natron præparatum. L. } gr. 10—30.
Aqua super-carbonatis Sodæ. E. lib. ½—1. in die.
Ad Calculum, &c.
Carbonas Zinci impurus. E.
Lapis Calaminaris. L. D.
Brit. Ung. et Collyr.
Oxydum Zinci impurum. E.
Tutia. L. D.
Brit. Ung. et Collyr.

To render this article the more complete, we shall add a few remarks upon the nature, use, and indications of the respective classes in the preceding system, as they may be inserted with more propriety here than in any other part of this work.

1. *Of Emetics.*

These may be regarded as irritative or evacuant, or both. Of the first we have instances in the sulphuret of antimony, the tartar emetic of popular language, sulphate of zinc, or white vitriol, and the sulphate of copper, or blue vitriol. Of the second we have instances in ipecacuanha and squills; of the third, in tobacco and foxglove.

From the use of emetic medicines the following direct effects are produced. They excite sickness, nausea, and their common attendants. They produce the action of vomiting itself. They occasion sudden and opposite changes in the circulation. They

increase the secretion or the discharge of secreted matter from the various glands which prepare fluids to be deposited in the alimentary canal.

The changes induced in the system in consequence of the primary effects of emetics are: the evacuation of the contents of the stomach, and, in some degree, of the upper part of the intestinal tube: free circulation through the stomach, intestines, and glands, whose secreted matters are acted upon: general agitation of the body: a commotion of the nervous system: a particular affection of the surface of the body. The indications which emetic medicines are capable of fulfilling, may be derived from the following sources: 1. Their producing agitation of the body, whence they may be employed, to restore uniform circulation. To promote diminished lymphatic absorption. To remove obstruction in the sanguiferous system. 2. From their producing evacuation by vomiting, whence they may be used, to discharge noxious matters taken in by the mouth; to discharge morbid accumulations of secreted matters lodged in the stomach; to evacuate serous accumulations. 3. From the affection of the nervous system which they occassion; whence they may be employed, to restore excitement to the nervous system in general, and obviate inordinate affections of the nervous energy. These indications may be illustrated and confirmed by attention to the use of emetics, when employed in cases of fever, dysentery, pulmonary consumption, jaundice, apoplexy, dropsy, and poisons.

In the use of emetics we ought to pay attention to the circumstances of infancy, old age, pregnancy, delicacy of habit, and plethora. The circumstances chiefly to be regarded with respect to the regimen necessary for this class, are, the state of the stomach when the emetic is exhibited; the means of facilitating the operation; the time of exhibiting the medicine; the temperature in which the patient is kept, after its operation is finished. The different individuals belonging to the class of emetics are chiefly contra-indicated by the presence of the following morbid states: a rupture or relaxation of containing membranes; topical inflammation of the internal viscera; a high degree of morbid debility in these; fixed obstructions to the circulation.

2. *Of Expectorants.*

The direct effects of the medicines which are employed under this name are as follow: they stimulate the lungs themselves; they augment the secretion taking place by the mucous glands of the lungs; they increase the excretion of mucus from the lungs. The changes induced in the system, from the primary effects of expectorants, are; an alteration in the state of the mucus excreted to a more thin and fluid consistence; an increase of the sensibility of the lungs; free circulation through the blood-vessels of the secreting glands; and the evacuation of those cavities in the lungs in which mucus is deposited.

Expectorants may be divided into the nauseating, as squills, gum-ammoniac, and garlic; the antispasmodic, as blisters, feet, and vapour-baths; and irritative, as acid vapours, and the common smoking of tobacco. The indications these medicines are capable of fulfilling may be traced as follows: 1. From their affecting the secretion of mucus; whence they may be used, to promote the secretion of mucus by the lungs, when morbidly diminished there; to render the mucus of the lungs thinner, when morbidly thick and viscid. 2. From their affecting the excretion of mucus; whence they may be employed, to evacuate morbid accumulations of mucus in the lungs; to supply irritation to the lungs when morbidly deficient. 3. From their effecting the state of the lungs themselves; whence they may be employed as local stimulants. The cautions to be observed in the employment of expectorants, as derived from their nature, chiefly respect their operations as exciting nausea; their power of stimulating the system in general from acting on the stomach; and their influence as irritating the lungs themselves. The conditions of the system which chiefly require attention in their employment are, the degree of irritability with which the lungs are endowed; and the youth of the patient. The circumstances chiefly to be attended to in the regimen necessary for this class, are, the state of the stomach; the employment of diet fitted to conspire with the effect of the medicine; the free use of exercise; and the state of the atmosphere in which the patient breathes.

The different individuals belonging to the class of expectorants, are chiefly contra-indicated by the presence of the following morbid states; a high degree of increased sensibility in the lungs; and an uncommonly quick excretion of mucus from the lungs.

3. *Of Diaphoretics.*

These are medicines, which, taken internally, increase the discharge by the skin,

without exciting this effect in consequence of violent agitation or acute pain. The following are their direct results: they accelerate the motion of the blood; produce free circulation through the vessels on the surface; and excite a discharge of sweat. The changes induced in the system, from the more immediate effects of diaphoretics, are, a change in the balance of the circulation; a diminution of the quantity of circulating fluids; and a diminution more particularly of the serosity.

Diaphoretics may be regarded as pungent, of which we have instances in spirit of hartshorn, oil of lavender, or amber; stimulant, as various preparations of antimony and quicksilver, guiacum, contrayerva, and snake-root; antispasmodic, as musk, opium and camphor; and diluent, as water and whey. Their use and indication may be collected, 1. From their changing the mode of circulation; whence they may be employed, to obviate morbid determination taking place to the internal viscera; to remove various causes obstructing or impeding the natural state of circulation on the surface; to restore the natural discharge from the body, which should take place by the surface, in those cases where it is morbidly diminished. 2. From their producing evacuation; whence they may be employed, to diminish the quantity of circulating fluids, where it is greater than the state of the system at the time can admit of; to restore diminished lymphatic absorption, and to discharge morbid accumulations of serum. These indications may be illustrated and confirmed, from practical observations concerning the effects of diaphoretic medicines in fever, dysentery, rheumatism, dropsy, and herpes.

The cautions to be observed in the employment of diaphoretic medicines, as derived from their nature, chiefly respect the determination they produce to the surface; the acceleration of the motion of the blood, which many of them occasion; the debility which, in consequence of the discharge, is produced in the system; and the effects sometimes produced on the vessels of the surface themselves, by the free passage of the blood through them. The conditions of the system, which chiefly require attention in their employment, are, the period of infancy; lax and debilitated habits; constitutions liable to costiveness.

4. *Of Diuretics.*

These are medicines which, from being taken internally, augment the flow of urine from the kidnies, by stimulating its secretion from the mass of circulating fluids. The changes induced in the system from these direct effects, are, a change in the balance of circulation; a diminution of the quantity of circulating fluids; but more especially of the serosity and of the saline parts of the blood; an increase of absorption by the lymphatic vessels; a diminution of the quantity of matter discharged by perspiration; and an uncommon flow of fluid through the urinary passages.

Diuretics may be divided into such as are stimulant, of which we have instances in squills, broom, colchicum, cantharides; refrigerant, as sorrel, berberry, vinegar, cream of tartar; and diluent, as water, whey, and acidulated waters. Their use and indication may be ascertained from the following effects: 1. Their producing evacuation; whence they may be employed to remove superabundant serosity from the blood; to evacuate morbid accumulations of serum; to remove morbid acrimony from the blood; to diminish the quantity of circulating fluids, when too great for the state of the system at the time. 2. From their altering the mode of circulation; whence they may be employed, to restore the natural secretion of urine, when morbidly diminished; to diminish other secretions, when morbidly augmented. 3. From their augmenting the flow of liquid through the urinary passages; whence they may be employed, to remove obstructions in these passages, and to wash out acrimony from them. These indications may be illustrated by an attention to the effects of this class of medicines as employed in ascites, ictorus, and nephritis.

5. *Of Cathartics.*

These are medicines which, taken internally, increase the number of stools by stimulating the alimentary canal, increasing the peristaltic motion of the intestines, and promoting the secretion of the fluids which constitute alvine evacuations. They may be subdivided into the following tribes:—stimulant, as jalap, aloes, bitter-apple; refrigerant, as Glauber's salts, sal polychrest, cream of tartar; astringent, as rhubarb, rose-leaves; and emollient, as manna, mallows, castor oil.

The changes induced in the system from the primary effects of carthartics, are, the evacuation of the contents of the intestines; a diminution of the quantity of circulating fluids, and, in a particular manner, of the

serosity; a change in the balance of circulation; a diminution of perspiration; higher excitement of the nervous energy in the system in general, but more especially in the intestinal canal.

The indications which cathartic medicines are capable of fulfilling, may be derived from the three following sources: 1. From their producing evacuation: whence they may be employed, to obviate morbid retention of the contents of the intestines; to diminish the quantity of circulating fluids when too great for the then state of the system; to evacuate morbid accumulations of serum. 2. From their altering the balance of circulation: whence they may be employed to promote free circulation through the intestines, in those cases where it is morbidly impeded; and to diminish the impetus of the blood against parts morbidly affected. 3. From the affection of the nervous system which they occasion: whence they may be employed to remove torpor in the muscular fibres of the intestines; and to restrain inordinate motions in their muscular fibres. These indications may be illustrated and confirmed, from considering the effects of this class of medicines as employed in dysentery, small-pox, dropsy, obstructed menstruation and diarrhœa.

The cautions to be observed in the employment of cathartics, as derived from their nature, chiefly respect the degree of evacuation they produce from the circulating fluids, and the topical irritation they occasion to the intestines themselves. The conditions of the system which chiefly require attention in their employment, are childhood, female habits, hysterical constitutions, high degrees both of irritability and torpor, remarkable delicacy of the stomach, and peculiar antipathies. The circumstances chiefly to be regarded with respect to the regimen necessary for this class, are, the mode of exhibiting the cathartic; the time at which it is given; the temperature in which the patient is kept during its operation; the diet employed; and the degree of exercise he uses.

The morbid conditions, contra-indicating the use of cathartic medicines, apply only to particular orders. The stimulant, refrigerant, and astringent, are contra-indicated by general inanition of the system; the stimulant by a high degree of irritability in the intestines, and by morbidly accelerated circulation; the refrigerant by a circulation unusually slow and languid; the astringent by habitual costiveness; and the emollient by uncommon relaxation of the bowels.

6. *Of Emmenagogues.*

By emmenagogues are meant medicines which possess a power of promoting that periodical secretion from the uterus which should take place in certain conditions of the female frame. The following, therefore, are their effects: They stimulate the whole circulating system. They stimulate, in a particular manner, the vessels in the neighbourhood of the uterus; and this effect seems, in some degree, to be communicated to the vessels of the uterus themselves. They occasion a particular affection of the whole nervous system. The changes induced in the system from the primary effects of emmenagogues, are, an increase in the impetus of the blood circulating through the uterus and its neighbourhood; and an augmentation of the quantity of blood determined to the uterus. From some individuals referred to this class, there arises an increase of the tonic powers of the vessels in the uterus, and from others a diminution of it. Emmenagogues may be divided into the following tribes: stimulant, as various forms of quicksilver and antimony; irritant, as aloes, savin, cantharides; tonic, as iron, cold-bath, corporeal exercise; and antispasmodic, as assafœtida, castor, warm foot-bath.

Their indications may be thus traced: 1. From their changing the mode of circulation, whence they may be employed to free the circulatory system in the neighbourhood of the uterus when obstructed there; to promote that accumulation of fluid in the vessels of the uterus themselves, which is necessary to the menstrual discharge: and to remove morbid obstructions to the passage of blood into the cavity of the uterus. 2. From their acting on the state of the animated solids. Hence they may be used, to increase the tonic power of the system where it is morbidly diminished. To increase the tonic power in the vessels of the uterus in particular, when deficient there. To remove spasmodic stricture taking place on the vessels of the uterus.

Practical observation in different cases of obstructed menstruation arising from different causes, will illustrate and confirm these various indications.

The cautions to be observed in the em-

ployment of emmenagogues chiefly respect the consequences of a cure if urged too precipitately or violently; the irritation produced to the intestines, and the stimulus affecting the whole system. The conditions of the animal frame which require attention in their employment, are, the age of the patient; the complaints to which she has formerly been liable; the duration of her present complaints; and her general character. The circumstances chiefly to be attended to in the regimen necessary, respect the temperature in which the patient is kept; the use of moderate exercise; and the employment of liberal diet.

In enumerating the morbid conditions contra-indicating emmenagogues, a distinction is to be made betwixt those which contra-indicate the restoration of the discharge altogether, and those which contra-indicate particular modes of restoring it. As morbid conditions, which entirely contra-indicate the restoration of this discharge, we may mention extreme debility, either constitutional, or induced by previous disease, which prohibit our attempting its restoration so long as the debility continues. The time of critical discharges; high degrees of irritability and torpor; and a constitutional disposition to *deliquium animi*. The circumstances chiefly to be attended to in the regimen necessary, respect the adapting the diet and temperature to the disease under which the patient labours; the time of performing the operation; the state of the ingesta at that time; and the mode of the discharge.

7. *Of Errhines.*

These are medicines which, when topically applied to the internal membrane of the nose, excite sneezing, and increase the secretion without any mechanical irritation. They may be regarded as of two kinds, sternutatory, or those used for the purpose of general agitation, chiefly, as tobacco, snuff, hellebore, euphorbium; and evacuant, or those designed to produce determination of the fluids to the nostrils, as asarum, beta, betouica.

The changes induced in the system, from the primary effects of errhines, are, violent agitation of the body; commotion of the nervous system; sudden changes in the circulation; a diminution of the quantity of circulating fluids; more free circulation through the mucous glands, on which the errhine acts; a change in the balance of circulation subsisting between these and the neighbouring parts.

The use of errhines may hence be ascertained by the following results: 1. From their producing agitation of the system in general; whence they may be employed to discharge morbid accumulations of mucus in the cavities surrounding the nose; to remove a state of torpor in the nervous system; to obviate nervous affections of the convulsive or spasmodic kind. 2. From their producing determination to the nose. Whence they may be employed to promote the secretion of mucus in the nose when morbidly diminished; and to occasion derivation from parts morbidly affected in the neighbourhood of the nose. These indications may be illustrated and confirmed from practical observations concerning the effects of this class of medicines when employed in cases of apoplexy, palsy, headach, and opthalmies.

The cautions to be observed in the employment of errhines, as derived from their nature, respect chiefly, the agitation they produce in the system in general, and the change they occasion in determination, whether as producing a greater flow to the nose, or derivation from other parts. The conditions of the system chiefly requiring attention in the employment, are, infancy, old age, irritable and hæmorrhagic habit, those which are morbidly torpid, and those formerly accustomed to the frequent use of the same stimulus. The circumstances to be attended to in the regimen necessary, respect the means of obviating inflammation when excited, and the avoiding sudden exposure to cold air.

The different individuals belonging to the class of errhines, are chiefly contra-indicated by the presence of the following morbid states: a high degree of plethora; morbid debility of the viscera; uncommon sensibility of the nose; preternatural determination to the nose; and ulceration of the nose or of neighbouring parts.

8. *Of Sialagogues.*

Sialagogues are medicines which excite an uncommon flow of saliva. They stimulate the salivary glands, or their excretories. They increase the action of the vessels secreting saliva. They accelerate the circulation through the salivary glands, and through the blood-vessels in the neighbourhood of these. They produce a preternatural discharge of saliva, both in point of quantity and consistence. The changes in-

duced in the system, from the primary effects of sialagogues, are, a change in the distribution of the fluids circulating through these vessels to which the action of the sialagogue extends, and through the vessels in the neighbourhood of these; a diminution of the quantity of circulating fluids in general; and a change in the state of the remaining mass, independently of the diminution of quantity. They may be distributed into topical, as squills, tobacco, peppers and other aromatics; and general, as mercurial preparations.

The use of sialagogues may be determined as follows: 1. From their effects as changing the balance of circulation, whence they may be employed to diminish the impetus of the blood against parts morbidly affected in the neighbourhood of the salivary glands; to diminish the action of the vessels when morbidly increased in these neighbouring parts; to promote free circulation of the blood through the salivary glands, when morbidly obstructed there. 2. From their effects, as producing evacuation, whence they may be employed to evacuate morbid accumulations of serum; to produce a thorough change in the fluids of the body, when morbidly vitiated.

These uses may be illustrated from practical observations in cases of tooth-ach, angina, dropsy, and siphilis.

The cautions to be observed in the employment of sialagogues, as derived from their nature, respect chiefly the stimulus they occasion to the salivary glands and neighbouring parts; the time required by the order of interna for the production of evacuation; the difficulty, perhaps, in some cases, the impossibility, of exciting salivation by means of the interna; and the debility induced in the system from excessive evacuation. The conditions of the system chiefly requiring attention in their employment, are, old age, constitutions habituated to sialagogues; peculiarities in constitution, determining the mercury to act on other parts than the salivary glands; menstruation; and pregnancy. Sialagogues are contra-indicated where there is an uncommon determination to the salivary glands; preternatural sensibility in them; deficient serosity; and general debility of the system.

9. *Of Emollients.*

By emollients are meant medicines which have a power of relaxing the living animal fibre, independently of mechanical action; they render the part to which they are immediately applied more soft and flexible than it was before. They excite a peculiar sensation indistinctly referred to the part to which they are applied; they produce through the rest of the system an effect in some degree analogous to that taking place in the part on which they more immediately act. The changes induced in the system from the primary effects of emollients are, a diminution of the power of cohesion in various parts of the animal body; a diminution of the tonic power in the system; an increase of the capacity of containing vessels in the part on which they more particularly act, and in some degree in the system in general; and an increase of irritability and sensibility through the entire frame.

They may be regarded as humectant, of which we have examples in warm water, warm vapour, and warm baths; laxative as marshmallows, mallows, white lilly root; lubricative, as bland oils, suet, hog's lard; atonic, as opium, foot-bath.

The curative indications of emollients may be collected hence: 1. From their producing a change in the state of the moving solids. Hence they may be employed to restore the natural flexibility to parts morbidly rigid; to diminish a morbid increase of tonic power. 2. From their producing a change in the state of the containing vessels. Hence they may be employed, to obviate the effects of morbid distention; to remove obstructions. These indications may be illustrated and confirmed, from practical observations concerning the effects of this class of medicines as employed in cases of contraction, rigidity and tumor. The cautions to be observed in the employment of emollients, as derived from their nature, chiefly respect their influence as acting on the system in general; and the effects of a degree of laxity induced in particular parts, higher than is natural to these. The conditions of the system which chiefly require attention in their employment are, the period of youth; delicacy of habit; and debility. The circumstances chiefly to be attended to in the necessary regimen, respect the temperature and air in which the patient is kept; and the mode of applying the emollient. The class of emollients are chiefly contra-indicated by the presence of the following morbid states: a high degree of morbid relaxation in the system in general; and a peculiar sensibility of the moving fibres.

10. *Of Refrigerants.*

These are medicines which, as their name implies, are supposed to diminish the heat of the living body, not by the application of an actual cold, but by a power peculiar to themselves.

They may be considered under the two divisions of acids or acetous fruits, as tamarinds, berberries, lemons, wood-sorrel; and neutral salts, as nitre, Glauber's salt, sal polychrest. They may hence be usefully employed; 1. In cases of febrile heat, or of general plethora, and an useful auxiliary to the tribe of refrigerant cathartics. 2. As sedatives to diminish undue irritability and action of any of the vascular systems, and are hence usefully conjoined with the sedatives more properly so called of Class XV. of this system. In the employment of these medicines attention should be paid to their power of diminishing action, and either generally checking the secretions of the system, or augmenting some by a diminution of others. Hence they are contra-indicated in cases of chlorosis, leucophlegmatic habits, and predispositions to dropsical affections. We enlarge the less, however, upon this subject, because the indications and contra-indications are closely connected, as we have just observed, with the articles and the remarks offered upon Class XV. of which, in various systems of therapeutics, they merely constitute a separate division.

11. *Of Astringents.*

These are medicines which possess a power of condensing the animal fibre without the aid of mechanical action. In general they are found to excite a peculiar sensation referred to the part to which they are applied; if to the organs of taste, a sense of dryness. They produce a remarkable corrugation in the parts on which they more immediately act. They occasion, in some degree, a similar affection through the rest of the system. Some individuals belonging to this class produce an evident condensation in dead animal fibres. The changes induced in the system from the primary effects of astringents, are: an increase of the power of cohesion in various parts of the animal body: an increase of what may be termed the tonic power in the system: a diminution of the capacity of containing vessels in the system: a diminution of irritability, and perhaps, in some degree, of sensibility.

Astringents may be divided into styptic, of which we have examples in most metallic oxids, as well as in aluminous earths: corrugant, as rose-leaves, galls, oak-bark; indurant, as alcohol and acids; and tonic, as exercise, cold, and friction.

The indications of cure which the class of astringent medicines are capable of fulfilling may be deduced from the following sources. 1. From the alteration they produce on the state of the moving solids: whence they may be employed, to obviate original delicacy; to restore natural compactness to parts morbidly relaxed; to restore diminished tonic power; to diminish mobility when morbidly increased. 2. From the alteration they produce on the state of the containing vessels: whence they may be employed, to diminish secretions morbidly augmented; to increase the power of retaining excrementitious matters when morbidly diminished; to produce a constriction on the orifices of ruptured vessels.

These indications may be illustrated and confirmed from practical observations concerning the effects of astringents in cases of hysteria, epilepsy, hæmorrhage, and diarrhœa.

The cautions to be observed in the employment of astringents, as derived from their nature, chiefly respect the stimulant and caustic powers possessed by many individuals belonging to the class: the effects of an alteration produced in the solids, if carried beyond the natural state; and, in a particular manner, their influence as diminishing secretions; and as increasing the power of the system for the retention of excrementitious matters. The conditions of the system which chiefly require attention in their employment, are, old age, melancholic habits, and particular morbid affections of the stomach. The circumstances chiefly to be attended to in the regimen necessary, respect, the avoiding a relaxing diet; and the keeping the patient in a cool temperature and dry air.

Astringents are chiefly contra-indicated by the presence of the following morbid states; a high degree of rigidity in the system in general; remarkable insensibility in the moving fibres; and particular diminution of the excretions from the body.

12. *Of Tonics.*

The medicines thus denominated are those which increase the tone of the muscular fibre, are supposed to brace the system when constitutionally relaxed, and give it

vigour when debilitated by immediate disease. They may be divided into stimulants, as various preparations of mercury, iron, zinc, and other metals; and astringents, as chamomile-flowers, myrrh, Peruvian, and other barks, and gentian. It is hence obvious, that this class of medicines has a near relation to those noticed in the class that immediately precedes, and immediately follows it. On which account we shall dismiss it with a single additional observation or two. The changes induced in the system by the use of tonics are, increase of muscular power, greater moderation, and a firmer stroke of the pulse, increased desire for food, and an augmented vivacity of the animal spirits. Hence their use is clearly indicated in all cases in which there is a deficiency of these natural powers or desires. They are therefore contra-indicated by the existence of a plethoric habit, constitutional predisposition to maniacal affections, or topical hæmorrhage, and a sanguineous temperament.

13. *Of Stimulants.*

These, like the last, are medicines which have a power of exciting the animal energy; but for the most part topically, rather than generally, or for a shorter period of time. They occasion a particular sensation referred to the part more immediately acted upon; frequently a sense of pain; they increase the action of muscular fibres in that part, particularly in its vessels; they increase the energy of the sensorium; they increase the nervous energy in the moving fibres through the system in general. The changes induced in the system from the primary effects of stimulants, are, acceleration of the motion of the blood in the part to which they are particularly applied; an increase of the force of circulation in the system in general; an increase of excitement in the powers of sensation; and an augmentation of mobility and vigour in the muscular organs. They may be divided into the following heads: topical, of which we have examples in mustard-seed, cantharides, mercurial preparations; diffusible, of which we have instances in volatile alkali, electricity, heat; cardiac, such as cinnamon, nutmegs, and other spices, and wine.

The indications of cure which stimulants are capable of fulfilling, may be derived from the three following sources: 1. From their affecting the state of circulation: whence they may be employed, to facilitate the passage of blood through parts in which it is morbidly obstructed; to augment the force and celerity of the circulation, where it is morbidly slow and weak. 2. From their acting on the powers of sensation: whence they may be employed, to quicken the senses where morbidly dull; to rouze the mental faculties when in a lethargic state; to exhilarate a despondent condition. 3. From their acting on the moving fibres: whence they may be employed, to restore the power of motion where morbidly deficient; to increase the strength of motion where morbidly weak. These indications may be illustrated and confirmed from practical observations concerning the effects of this class of medicines, as employed in cases of syncope, apoplexy, and palsy. The cautions to be observed in employing stimulants, are, the pain they excite, the violence of circulation, or the flow of the animal spirits which they produce, the mobility of the system which arises from their employment, and the collapse, which is the consequence of high and sudden excitement. The conditions of the system, which chiefly require attention in their employment, are delicate and irritable habits. The circumstances chiefly to be attended to, in the regimen necessary, respect the diet and temperature best adapted to the stimulant employed, and the nature of the particular disease in which it is used. The individuals belonging to this class are chiefly contra-indicated by the presence of the following morbid states: a high degree of morbid irritability; the circulation uncommonly accelerated; and a preternatural disposition to hæmorrhage.

14. *Of Antispasmodics.*

By these are meant whatever has a power of allaying inordinate motions in the system, particularly those involuntary contractions which take place in muscles naturally subject to the command of the will; they counteract and remove various causes exciting contractions; they diminish the influence of the nervous energy in the parts spasmodically affected. The changes induced in the system, from the primary effects of antispasmodics, are, the restoration of the proper balance of the nervous energy in different parts of the body, the restoration of the due influence of the will, and the restoration of the natural state of tension to the muscles. The different articles referred to the class of antispasmodics may be distributed into the two following orders: sti-

mulant, as volatile alkali, essential oils, ether; sedative, as camphor, musk, opium.

As the action of the medicines referred to this class, depends entirely upon the presence of a morbid state, what has been advanced with regard to their nature, will, in a good measure, serve to illustrate their use. The indications of cure which, as antispasmodics, they are capable of fulfilling, are entirely to be derived from their influence on the nervous energy: whence they may be used, to remove spasmodic contractions taking place in different muscles, to allay convulsive agitations. These indications may be illustrated and confirmed from practical observations concerning the effects of antispasmodics, as employed in cases of epilepsy and cramp. The circumstances claiming attention in the employment of antispasmodics, which respect either the nature of the medicine itself, the condition of the patient in whom it is used, or the necessary regimen, are different according to the particular order which is employed. They will easily be understood from what has already been said of stimulants and sedatives, considered as separate classes.

There is, perhaps, no condition of the body which will contra-indicate the use of every individual referred to the class of antispasmodics. But the same morbid conditions, which have already been mentioned, as contra-indicating the use of stimulants and sedatives, will likewise contra-indicate the orders of antispasmodics denominated from these classes.

15. *Of Narcotics.*

These are medicines which have a power of diminishing the animal energy, and hence inducing torpor and sleep, during which this energy is usually recruited and restored. They diminish the sensibility of the part to which they are particularly applied. They diminish the action and tonic power of its muscular fibres. They produce a peculiar sensation in the system in general. They diminish the energy of the sensorium.

The changes induced in the system from the primary effects of narcotics are: retardation of the blood's motion in the part more immediately acted upon: diminution of the force of circulation in the system in general: diminution of excitement in the powers of sensation and reflexion: and diminution of vigour in muscular action through the system.

Narcotics may be divided into those which act directly, and those which act indirectly. Of the former tribe are poppies, opium, hyoscyamus, hops, and lettuce; of the latter, neutral salts and acids. Their use may be calculated from the following sources: 1. From their affecting the circulation; whence they may be employed to diminish the force and celerity of the blood's motion where morbidly augmented; to diminish the impetus of the blood against parts morbidly affected. 2. From their acting on the powers of sensation; whence they may be employed to abate violent pain; to procure sleep, in cases of preternatural watchfulness. 3. And from their acting on the moving fibres; whence they may be employed to restrain inordinate motions, and to moderate excessive evacuations. These indications may be illustrated and confirmed from practical observations concerning the effects of this class of medicines, as employed in cases of inflammation, toothach, and dysentery. The cautions to be observed in the employment of this class of medicines, as derived from their nature, chiefly respect, the insensibility which they produce; the atony they occasion in the muscular fibres, particularly in the blood-vessels; and the suspension of the powers of sensation with which they are sometimes followed. The conditions of the system which chiefly require attention in their employment are, irritable and relaxed habits; and such as are constitutionally liable to delirium from their use. The circumstances chiefly to be attended to in the necessary regimen, respect the regulation of the dose of the medicine employed; the avoiding all stimulating causes during their operation; and the guarding against their becoming habitual to the system. Narcotics are chiefly contra-indicated by a preternaturally languid circulation; a peculiarly lethargic disposition, and great morbid torpor in the system.

16. *Of Anthelmintics.*

By anthelmintics are meant those medicines which, without endangering the life of the patient, are effectual in procuring the removal of worms lodged in the human body. The direct effects arising from this class of medicines are intended to be exerted only on the worms themselves; but there are at the same time few, if any, medicines, which, when employed with this intention, do not also produce some effect on the animal body: to enter upon the consideration of these, however, would be

foreign to this class. As anthelmintics they produce the following effects. They kill worms to which they come to be applied in the body. They expel them from the body. They prevent their generation in the body. The only changes produced in the system, that are here to be considered, are those which arise from their action upon the worms themselves. These are, the removal of an almost infinite variety of different symptoms which worms produce whilst lodged in the body. Anthelmintics may be subdivided into the following tribes: *poisonous*, as quicksilver, tin, sulphur; *lubricant*, as oil of olives and oil of linseed; *tonic*, as savin, tansy, santonicum; *cathartic*, as scammony, jalap, aloes, gamboge. Their indications are manifested from the following considerations: 1. From their action on the worms themselves; whence they may be employed to kill worms lodged in different parts of the human body. 2. From their action on the system; whence they may be used to promote the expulsion of worms from the body, whether dead or alive; to prevent the generation of worms in the body. These indications may be illustrated and confirmed from practical observations concerning the use of anthelmintics in cases of atrophy, diarrhœa, and vomiting.

The cautions to be observed in the employment of anthelmintics, as derived from their nature, chiefly respect the other effects they have upon the system, independent of their action as anthelmintics. The conditions of the system which chiefly require attention in their employment are infancy, delicacy of habit, and other similar affections. In the regimen farinaceous food should be avoided; and exercise should be encouraged.

There are, perhaps, no morbid conditions of the system, during which the removal of worms from the body may not with propriety be attempted by one mean or other. But, although it may be doubtful whether there be morbid conditions contra-indicating the whole class, yet it cannot be questioned that there are many contra-indicating particular orders. Among others may be mentioned: an abraded or inflamed state of the intestines, contra-indicating the poisonous; accumulations of feces in the first passages, contra-indicating the lubricant; a peculiar sensibility of the stomach, contra-indicating the tonic; and topical inflammation of the intestines, previous looseness, or a high degree of inanition, contra-indicating the cathartic.

17. *Absorbents.*

This term is used differently by different therapeutists. Generally speaking, it implies medicines which, possessing no acrimony in themselves, possess, notwithstanding, a power of destroying acidities in the stomach and bowels: at other times, however, it is employed more largely to indicate those substances, as well, which increase the general action of the absorbent system. They may hence be divided into two kinds: the calcareous, as burnt hartshorn, oyster shells, and chalk; and stimulative, as burnt sponge, salt of hartshorn, and alkalies. They are hence indicated in peculiar acrimonies, or peculiar torpidities of the system generally, or particular organs of the system; and may hence be employed beneficially in acidities of the stomach, heartburn, and excesses in a vinous potation; as well as in strumous and other leucophlegmatic affections of the glandular system; especially in bronchocele, or the disease termed provincially Derbyshire-neck, and scirrhosities of either extremity of the stomach. Their use may be collected from practical attention to these diseases, in which, notwithstanding, they commonly require to be connected with more active applications. On this last account they may generally be employed without apprehension: yet in cases of acidity of the stomach, they have often been used to an extent that has produced worse diseases than the malady they were intended to remedy, and have laid the foundation for calcareous concretions, that have resisted the application of almost every purgative, and formed indurations almost as troublesome as the calcareous concretions of the bladder: concretions which have only been removed by a long use of active lithontriptics.

MATHEMATICAL *instruments.* Under this term we shall treat of the instruments usually sold in cases, and made on a portable plan, so as to fold up into a small space, to be carried in the pocket without injury to any part. These cases are made either vertical, or horizontal; but the latter mode is far preferable, although the bulk is, in this form, somewhat augmented, because the points are kept in a better state of security; an object of the utmost importance to the mathematician; since the excellence of the compasses, and drawing pens in particular, will, in a great measure, depend upon the delicacy of their terminations. The whole of the steel-work in a case of instruments should be of the

best finish, duly tempered, and fitted with scrupulous exactness; the hinges in every part should fit close and firmly; having screw-pivots, in order that they may be taken to pieces on occasion. The screws ought to fit into female sockets of steel; those of brass being extremely liable to wear out in the thread, or worm, and to cause the parts that depend on their motion to be lax and uncertain. The protractor and sector should be of very fine clear ivory, and the parallel ruler may be of the same, or of ebony: but which ever it may be made of, the utmost care must be taken to preserve it from warping, while its edges, as well as those of the other flat instruments, ought to be guarded from injury. The protractor especially should never be touched by a knife, or by any sharp or hard instrument, when drawing lines along its edge. When describing its uses, the reader will collect proper ideas regarding the absolute necessity for preserving its edges from the smallest diminution or irregularity; since the most trivial defect therein could not fail to render the whole of its operations precarious. We are disposed to think that the flat instruments are usually made rather too thin, whence they are easily warped by change of weather, or by being kept in too warm a situation; leaving them exposed to a hot sun is extremely injudicious.

Having said thus much respecting the materials of which they should be formed, we shall detail the uses and proportion of each instrument separately. The pencil ought to be of very pure lead, such as is free from ore, and that cuts to a fine point without offering too much resistance to the knife; the surface of the lead should, when cut, appear very smooth and glossy, without any flaws, or resemblance of antimony: the mark left on paper should be perfectly superficial, and exempt from any impression or scratch, which bad pencils invariably make, and which cannot be erased or defaced without giving the paper a rough surface, and a disposition to absorb; so as to shew blotty when colours are used. Some judgment is required to distinguish the fine pencils, made of solid lead ore, from those which are vended by Jews, and, indeed, by some who call themselves respectable manufacturers of this article. The inferior kind are made of black-lead dust, cemented with glue, gum, starch, linseed-tea, and a variety of such adhesive matters, according to the degree of hardness the composition is intended to bear. When we see "hard lead," and "soft lead," impressed on the cedar casings of black-lead pencils, we may generally suspect their quality; for though the best makers occasionally make a distinction in regard to the hardness or softness of the lead, they usually sort such into different chests, and vend to the retailers according to their fancy, or to the predilection shewn by their respective customers. We, therefore, recommend to persons wishing to obtain good black-lead pencils, that they purchase by the gross, from the most eminent makers; or that they give a good price for them at those warehouses where articles in the drawing line are sold in perfection. In tapering a pencil to a fine point, it is necessary, after the shape may have been generally given, to hold the point against the inside of the tip of the forefinger of the left hand, cutting from you very carefully, and turning the pencil round as may be necessary. By this means the point is supported, and may, when the lead is very good, be made to taper beautifully, without danger of being broken by the operation.

The compasses given in a complete case vary, being intended for various different purposes. First, a pair of hair-compasses, so called because by means of a screw near the middle of one limb, a spring, which unites with the steel-leg, may be acted upon, so gradually as to cause the points to give the most precise measurements. When compasses are relaxed too much at the joint they should be tightened, by means of two little apertures that are on each side of the pivot-head. In these the two small studs that appear on the turnscrew are applied, either to pinch tighter, by turning with the sun; or to relax, and even to separate the two limbs, by turning against the sun. If the points of compasses are not duly tempered, they will prove very troublesome; when too brittle, they will be perpetually snapping; and when too soft, they will be subject to bend. The mathematician will occasionally have to work on substances harder than paper; therefore the temper of his points is a matter of some importance. If too highly tempered, he should heat them near the flame of a candle until they change to a straw colour; when they ought to be instantly plunged into a lump of soap, or of tallow, &c. When too soft, let the points be heated to a bright red, and then be suddenly immersed in water in which salt-petre has been

dissolved. The points of compasses ought to be very even, and the two sides that lay together, when they are closed, should never be ground, or rubbed, except to take off the rough point sometimes occasioned by setting the two other sides of each point. The puncture made by compasses ought to be barely visible; consequently the points should be extremely fine: hence also we see the necessity for avoiding to press upon compasses while measuring on paper, &c. as their own weight will, generally, cause them to leave a sufficient impression for mathematical purposes.

Besides the hair-compasses, there is usually a rather longer pair, of which one of the steel legs draws out altogether, for the purpose of being replaced by a brass limb, with a port-crayon, a dotting-leg, &c. The former has a pair of clasp-springs, acted upon by a ring of the same metal, to secure a piece of fine black-lead pencil, which should be cut to a fine point, exactly level with the other leg of the compass. This is meant for drawing circular lines. The dotting-leg is for making dots in circular figures, and bears a small brass graduated wheel between two side pieces, from which it derives its supply of ink. The dotting-leg is, however, best used dry; when the marks made by the impression of the gradations on the wheel may be followed by a pen. The wheel is apt to let the ink fall, and to make sad blotted work. A third limb is likewise applicable in this instance, *viz.* a drawing pen, intended to make ink lines in circular figures; the sides of this are two steel slips, bending towards each other at their ends, which are finished so as not to cut the paper, but to make a line of any strength, according as the ink may be allowed to pass, more or less freely, by the expansion or contraction of their points, as acted upon by a small screw about the middle of their bend.

There is also a neat small pair of compasses intended for drawing circles, &c. of a small diameter; in these there is only a fixed drawing limb, in lieu of a plain steel leg: they are highly convenient when the longer compasses are in use for dotting, and are capable of doing the work, which comes within a small radius, to great nicety; not being so apt to jump as those of a longer size, when the circles are very small. The inventor of this instrument was named Bowes, whence it bears that designation; though some have vulgarly corrupted it to "bow-compasses."

The proportional-compasses consist of two flat brass limbs, both of which bear steel points; a screw, sliding in a groove, connects them; and by being tightened at pleasure enables the operator to slide the bridge along so as to be fixed at any point on the lateral tables. When closed the two limbs, and their respective points, appear but as one piece, and are kept to that position by a small stud in one, which fits into the other half. This instrument must be perfectly closed before the bridge is moved, else the channels of the two limbs will not lay in a right line. Four tables are engraved on these compasses, *viz.* on one side a table of circles, on the other side (of the same face) a table of lines. By applying the index on the bridge to the several lines, as numbered in the former table, the radius of a circle being taken between the long points, at one end of the compasses, the shorter points, at the other end, will give such part of the circumference as the bridge may be placed against: thus, if the seventh part of a circle be required, close the compasses and slide the bridge, bringing the mark on it into an exact line with the mark at 7 in the table of circles; then screw rather tight, and open the long points equal to the radius of the circle; the other points will give a measurement, between their points, equal to a seventh part of that circle's circumference; and give the face of a regular polygon of seven sides.

The proportional parts of lines are ascertained in the same manner, by setting the index to that table, the long points measuring the whole line, and the short ones giving the part required, according to the figure against which the index on the bridge is set.

The line of plans, or of squares, shews the areas under the different figures: thus, set the index to four, the measure between the long points will give a square four times as large (in contents) as a square made with the measure between the small points on one of its sides: thus, if the square made on the latter contained six square inches, that made on the former would give an area equal to twenty-four square inches.

The line of solids shews, in the same manner, the difference between the solid contents of bodies of a regular figure: in this case, however, the bodies must be similarly quadrangular, such as cubes; or spherical, as balls, globes, &c.; then, by taking their diameter, the table will indicate the difference of their solid contents; the small points being considered as implying unity,

Triangle-compasses are made for the purpose of ascertaining three points, in the same manner as the common biped-compasses ascertain only two. This is affected by a third leg, which may be taken off at pleasure, working like a gin for raising weights; or like the legs of a theodolite-stand, and having a hinge at right angles with that where it joins the top of the compasses. By this simple contrivance the added leg may be made to incline to the right or left of the direction given by the upper hinge.

Where work is to be executed on a large scale, *viz.* projecting meridians in maps, it is necessary to have a very large pair, such as are known at the makers by the designation of beam-compasses: these may be had in separate cases, with covers sliding in grooves, and to the extent of full two feet in length. In some professions such are indispensable, but it is far more convenient to have a branch, or elbow-joint, to the shifting compasses; the upper part fitting into the socket made for receiving the several limbs, and its lower end being socketed in the same manner; so that one leg of the compasses may be made, to any extent, longer than the other. As all the additional joints have a hinge, the excess of length may be made subservient to any direction, by being bent downwards, so as to stand at right angles with the paper; as in such case the other leg ought also, in order to prevent its shifting, or cutting the surface. The elbow-joint is often given in a flat case of instruments.

The drawing-pen is ordinarily about six inches in length, and is made on the same principle as that intended for circular operations; in general, this unscrews in the centre, and disengages the upper part of the handle, to which a fine steel needle is attached, the use of which is to mark down, by the slightest puncture, those points that require peculiar delicacy. The small flat steel turn-screw has one end narrowed that it may fit the screw-heads in the hinges of compass limbs; while the other, by means of two studs that fit into corresponding holes on the side of the joint connecting the two limbs of the compass, serves to tighten or to relax them at pleasure.

The common parallel rules made to fit into cases, consist of two slips, moving upon four pivots; *i. e.* one at each end of two metal plates, whereby the slips are always kept at a perfect parallel. This chiefly depends on the perfect equality of lengths in the metal slips, and their being placed at exactly the same angle, at points equidistant from the edges of the slips. Some parallels have a third piece, which folds between the two above described, and requiring an additional pair of metal hinges, which meet on them as a centre. This is certainly a very great convenience, inasmuch as it extends the scope of the instrument, and gives a third parallel; but the slightness of the middle piece subjects it to warp; and, at all events, demands great care in using, so as not to wrench the pivots, or to bend them into an improper direction, whereby the whole work would be falsified. In drawing lines with this ruler, observe the following instructions: When a parallel is to be made above the line to which you apply the ruler, let the limbs be closed, then press firmly on the bottom slip, by two fingers placed at least two inches apart, and clear of the hinges; slide the upper limb gently from you, by means of the metal stud in its centre, until you bring it up to the point through which the parallel is to be drawn. When you would make a parallel below any given line, the slips should be separated (keeping the upper limb well pressed by two fingers), until you bring the upper or lower edge of the other limb, as may prove most convenient, to the point through which the parallel is to be made. Or you may open your ruler to its full extent; first, placing its upper thin edge along the original line, and pressing on the lower limb, then draw the upper one down to the desired point. Both the edges of this ruler are chamfered on one side only; whence one edge lays very flat to the paper, so as to guide with great exactness, and serving excellently for pencilled lines; while the other, being raised from the paper, gives greater security from blotting when ink is used, but requires a very steady hand, and a no less accurate eye.

Parallel rulers are sometimes made to move on wheels, with graduated edges, shewing the parts of inches over which they pass. The theory is excellent, but we find in this many practical inconveniences; such rulers being easily turned out of their proper directions, by any little inequality on the surface of paper, or by the smallest deviation from perfectly even propulsion, or retraction. Besides, the axis being necessarily made loose, so as to allow great freedom of motion, it is obvious the wheels cannot always preserve an exact level;

whence the instrument must move as though of a conical form, and give concentrating, instead of parallel lines. Hence such rulers are deservedly discarded in most instances; though, for work requiring more celerity than accuracy, they may be found to answer.

Protractors are chiefly made of ivory, in the form of a thin flat scale, or ruler, of which one side is plain, excepting a very small nick, or mark, that points out its exact centre, and corresponds with a line, perpendicular to it, on the opposite edge, marked 90, dividing the instrument into two equal and similar portions. The edges on three sides of the protractor are graduated with 180 degrees, backwards and forwards, the centre point 90 being a right angle. The protractor is used for laying down angles to any extent, as also for taking their measurements: hence it is of extreme service in every branch of mathematics, and indeed of mechanism. On the same side, with the gradations, we generally find a line of chords on an extensive scale. We shall explain its construction when we treat of the sector, observing in this place, that by its aid we are enabled to set off any angle without the assistance of a protractor: thus, take the measurement of 60°, from the line of chords, as a radius wherewith to describe any segment at pleasure, putting one foot of your compasses at the point whence the angle is to proceed, and commencing the segment from that line whence the angle is to be made. Take then from the line of chords the number of degrees you intend the angle should contain; set them off upon the segment from the place where it joins the line; the angle will be thus made, leaving the centre whence the radius was drawn for its point, and the two ends of the chord that cut off the segment for its measurement. See GEOMETRY and DIALLING.

Some protractors are made of brass, in the form of a semi-circle; they are precisely on the same principle, but are more calculated for the measurement than for the construction of angles; because they expose the directions of lines, however short, and enable us, by means of any right line instrument, laid from the centre to the circumference, to ascertain the angle without extending the line, as must be done when an ivory protractor is used to a short line.

On the back of the protractor there are usually six scales, marked 60, 50, 45, 40, 35, and 30; meaning that the measures, or equal points, 1, 2, 3, &c. respectively include 60, 50, &c. such within the length of an inch; the number 1, 2, 3, &c. being considered at 10, 20, 30, &c. of such small divisions as are placed at the commencement of each scale respectively. The scale marked C, standing on the same line with that of 60 to an inch, is a line of chords on a reduced scale, for the convenience of persons working on such; and the broader scale, of 10 lines in depth, is of half and quarter inch divisions, with oblique scales at the two ends. These shew all the tenths of a half, or of a quarter of an inch respectively, according as the oblique line gives more space between it and the first perpendicular, as may be seen by referring to the figures 2, 4, 6, 8, which shew $\frac{2}{10}$, $\frac{4}{10}$, $\frac{6}{10}$, $\frac{8}{10}$ of the division, and enable us to embrace any number of whole divisions, and of tenth parts, within our compasses, with readiness and precision. This is intended chiefly for work on a larger scale, such as ground-plans, &c.; though for such purposes, a scale divided into twelfth parts is more convenient; since it takes feet and inches, instead of decimals of feet.

It is proper to remark in this place, that the protractor should be prevented from warping, else its measurements of angles will not be true. When this defect has taken place, it will be necessary to press the instrument; thereby to bring it as flat as possible, that the measurements may be accurate, by the bearings being restored to their proper places.

The sector is made to fold in the middle, not only that it may lay in a smaller compass, but to solve many problems by means of the references given to various tables and scales that are engraved on both sides of each limb. When opened to its full length, the sector commonly measures one foot; each inch being numbered, and divided into tenth parts, called lines. At the edge is another scale, which divides the foot into ten equal parts (numbered 10, 20, 30, &c.) because each tenth part of the foot is again subdivided into ten; thus giving a division of the twelve inches into 100 equal parts.

The first scale we shall notice is that next to the inner edges, marked Pol. meaning polygon. By opening the sector to such a width, as may admit the radius of any circle to measure exactly from the figure 6, on one, to the figure 6 on the other limb, we at once ascertain the division of that circle's

circumference into any number of equal parts, from four to twelve; because from the figure 4 to the opposite figure 4 will give a chord subtending a quadrant of the circle; from 5 to 5 will give the side of a regular pentagon, or figure of five sides; from 6 to 6 a hexagon; and so forth.

The line of chords on the sector is known by the letter C on each limb, and measures 60 degrees only; though on the protractor it goes as far as 90, which is its full measurement. This, however, is not important, as we can always add 30 to 60, and thus complete any figure in hand. The formation of the line of chords being given, its application will be more readily understood; we shall therefore shew how they are constructed from the circle.

Suppose the line A B (fig.1, Plate Miscel.) to represent the end of your scale, and that A C, B D, be perpendicular thereto: with A B as a radius, and from A as a centre, draw the quadrant B F C, and the straight line or chord B C subtending that quadrant. Divide the quadrant into 90 equal parts, and from B, as a centre, measure off each division successively, so as to cut the chord B C into 90 parts, all which will be unequal. Mark every tenth degree, both on the quadrant and on the chord, thus, 10, 20, 30, 40, 50, 60, 70, 80, and 90. This division will make the line B C a line of chords, which affords a scale of very general utility in mathematics.

The line of sines, commonly marked S, shews the relation of sines to various portions of circles. Here it is necessary to state, that there are three kinds of sines, *viz.* the sine, the co-sine, and the versed sine. The sine is that perpendicular which stands at right angles with the chord subtending an arc, and reaches from it to the circumference, such as the line E F; the co-sine is a chord, such as F G, which commences from the junction of the sine with the circumference, and is parallel with that line from which the sine arises, proceeding in that direction until intercepted by the perpendicular A C, which terminates the quadrant; the co-sine is therefore the complement or residue of the base line A B, after deducting from its other end the amount of the versed-sine B E. If from B 60 degrees be measured on the quadrant to F, its sine will divide the base A B into two equal parts; so that the co-sine and versed-sine will be of equal length. The line of sines is therefore made on the perpendicular A C by means of parallels, to the base A B, drawn from the circumference at the parts marked 10, 20, 30, &c. degrees, which of course give a regularly diminishing scale.

The line of tangents is made by a continuation of the perpendicular B D to K, and by drawing from the graduated quadrant the several lines 10, 10; 20, 20; 30, 30; &c. to that perpendicular, all pointing to the centre A. This scale regularly augments, and is carried to 45 degrees only. Now, by transferring all the tangent scale, and the places of the degrees thus obtained from the point A, by drawing segments from each part respectively to the perpendicular A H, we have a line of secants: thus the 10 on the tangent scale will be transferred to 10 beyond C on the secant line, 20 to 20, and thus to the end of the scale up to 90 degrees, which would, however, acquire a great length of ruler. The line of tangents is confined to 45 degrees; but a line of lesser tangents, from 45° to 90°, is made on a smaller radius.

The line of equal parts between A and B is also called the line of lines, and is divided into 10, 100, 1000, &c. equal parts; but the indicial numerals are confined to 10, for we have only ten numbers on each limb of the sector, made by dividing the radius (or base line) A B into that number of equal spaces. The uses of the lines above described are very extensive; but we shall give a brief example of their intentions, observing that the line of equal parts is distinguished by the letter L on each limb of the sector: the line of sines, by S; the line of tangents, by T; the line of secants, by *se.*; and the line of lesser tangents, by *ta.*

N. B. In some sectors the letter C is engraved close to the very centre of the hinge, which centre is marked by an obvious puncture, towards which all the lines have a tendency: in using the lines, the measures are to be taken from those marked L. S. C. &c. on one limb to those marked L. S. C. on the other limb, respectively, they standing at an angle of six degrees from their respective partners.

"To find a fourth proportional by the line of equal parts." Say you would wish to find a line proportioned to 15 as 3 is to 8: on the line of equal parts take a distance from C with your compasses equal to 15, and with that opening extend your sector so as the distance between 3 and 3 may correspond therewith; then measure the distance thus generated between 8 and 8, and lay it from the point C along the line of

equal parts: it will fall on 40, which is in the same proportion to 15 that 8 is to 3. And this is demonstrable by common arithmetic; for 3 being ⅜ of 8, and 15 being ⅜ of 40, the solution given by this scale must be correct. This depends entirely on the mathematical axiom; *viz.* that "parallel lines under the same angle are to each other in proportion to their respective distances from the angular point."

"To set off an angle by a line of chords of 60° only," (fig. 2.) Open the sector to any extent at pleasure, and with the distance between 60 and 60 describe a segment at least equal to the space you think the angle will occupy. On the same line of cords take on your compasses, the number of degrees you intend the angle to be, say 27, and applying one leg to the commencement of your segment, (which we suppose to be a given point on a given line) measure the same space on the segment. The two points thus ascertained on the segment will show an angle of 27 degrees; which will be better seen by drawing lines from them respectively to the centre where the segment was described. When the angle is to be more than 60 degrees, another operation on a second line, made at 60 degrees, will give the angle required: thus you may make an angle of 60 degrees in the intended direction; and if the whole angle to be made amount to 73, you may add a second angle of 13. But the neatest and shortest way is to draw a perpendicular to the given line, on the point whence the segment arises, and from that to make an angle equal to the complement: thus, if the angle is to be 73, from the base line, you should make an angle equal to 17, which added to 73 complete 90 degrees, and thus obtain the desired angle by inversion.

"A line being given, to find the sine of a segment whose radius shall be the hypothenuse of a triangle (at any given angle), formed by that line, as a base, and by the sine as a perpendicular thereto," (fig. 3.) Here we have one of the most important, yet simple, operations in mathematics; *viz.* the ascertaining a sine upon an undescribed segment. Let the base line, A B, be 174, and the given angle be 42; make the angle at one end, B, of the base, and at the other, A, raise a perpendicular which is to become the sine, when intercepted by the hypothenuse C B. Take 174 from the line of equal parts on your compasses, and open your sector until the distance between 48 and 48 on the lines of sines corresponds therewith. Now measure the distance between 42 and 42 on the lines of sines, and their result, 162, will be the length of the sine to a segment, of which the hypothenuse of the triangle is radius, and whose versed sine will be found by continuing the base line until it meets the segment: the base line in this case will be equal to the co-sine; since a perpendicular raised at the angular point parallel to the sine, A C, would, if the segment were continued thereto, complete the quadrant of a circle.

But if, instead of taking the hypothenuse for a radius, we take only the length of the base line; and from the same point as before, draw a segment, A D, from the end of the base to the hypothenuse; then, instead of being a sine, the line whose length we have just ascertained to be 162 will be a tangent, and comes under the next example.

"To ascertain the length of a tangent under a given angle, on a given line." Take the distance 174 (equal to the radius), from the line of equal parts, and open your sector, so that it may be the distance between 45 and 45 on the lines of tangents. Then take the distance from 42 to 42 on the same lines, and it will be found equal to 162 on the line of equal parts. Hence we see that the tangent of a segment made on the base as a radius is the line of a segment made on the hypothenuse as a radius; the angle in both instances being the same, and not exceeding 45°.

"To find the length of the secant in the same figure." Take the length of the base, as before, from the line of equal parts, and spread the sector until that measure reaches from 0 to 0 (that is from the very beginning) of the lines of secants; measure the distance from 42 to 42 on the lines of secants; it will reach to 238 on the line of equal parts, and give that for the length of the hypothenuse, which is in this case considered as a secant.

Besides the lines already described, there are some that require the sector to be completely unfolded, so as to be all in one line. These are the artificial lines of numbers, sines, and tangents, taken from Gunter's tables, which depend on logarithms for the solution of their operations; as will be seen under the head of NAVIGATION, in which the properties of Gunter's scale are illustrated.

MATHEMATICS, originally signified any discipline or learning; but, at present, denotes that science which teaches, or con-

templates, whatever is capable of being numbered or measured, in so far as is computable or measurable; and, accordingly, is subdivided into arithmetic, which has numbers for its object, and geometry, which treats of magnitude. See ARITHMETIC and GEOMETRY.

Mathematics are commonly distinguished into pure and speculative, which consider quantity abstractedly; and mixed, which treat of magnitude as subsisting in material bodies, and consequently are interwoven every where with physical considerations. Mixed mathematics are very comprehensive; since to them may be referred astronomy, optics, geography, hydrography, hydrostatics, mechanics, fortification, navigation, &c. See ASTRONOMY, OPTICS, &c.

Pure mathematics have one peculiar advantage, that they occasion no disputes among wrangling disputants, as in other branches of knowledge; and the reason is, because the definitions of the terms are premised, and every body that reads a proposition has the same idea of every part of it. Hence it is easy to put an end to all mathematical controversies, by shewing either that our adversary has not stuck to his definitions, or has not laid down true premises, or else that he has drawn false conclusions from true principles; and in case we are able to do neither of these, we must acknowledge the truth of what he has proved.

It is true, that in mixed mathematics, where we reason mathematically upon physical subjects, we cannot give such just definitions as the geometricians: we must, therefore, rest content with descriptions; and they will be of the same use as definitions, provided we are consistent with ourselves, and always mean the same thing by those terms we have once explained. Dr. Barrow gives a most elegant description of the excellence and usefulness of mathematical knowledge, in his inaugural oration, upon being appointed Professor of Mathematics at Cambridge.

The mathematics, he observes, effectually exercise, not vainly delude, nor vexatiously torment studious minds with obscure subtilties; but plainly demonstrate every thing within their reach, draw certain conclusions, instruct by profitable rules, and unfold pleasant questions. These disciplines likewise enure, and corroborate the mind to a constant diligence in study; they wholly deliver us from a credulous simplicity, most strongly fortify us against the vanity of scepticism, effectually restrain us from a rash presumption, most easily incline us to a due assent, perfectly subject us to the government of right reason. While the mind is abstracted and elevated from sensible matter, distinctly views pure forms, conceives the beauty of ideas, and investigates the harmony of proportions; the manners themselves are sensibly corrected and improved, the affections composed and rectified, the fancy calmed and settled, and the understanding raised and excited to more divine contemplations.

MATRASS, CUCURBIT, or BOLTHEAD, amongst chemists. See LABORATORY.

MATRICARIA, in botany, *feverfew*, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx, hemispherical, imbricate; the marginal scales solid, sharpish; down none; receptacle naked. There are eight species. These are herbaceous plants, with leaves mostly pinnate, in some few simple; flowers terminating either in corymbs, or almost solitary; florets in the ray commonly white. M. Parthenium, common feverfew, is a native of many parts of Europe, in waste places, in hedges and walls, sometimes in cornfields and gardens, where it is also cultivated in a double state.

MATRIX, in anatomy, the same with uterus.

MATRIX, in letter-foundery. See FOUNDERY.

MATROSSES, are soldiers in the train of artillery, who are next to the gunners, and assist them in loading, firing and spunging the great guns. They carry fire-locks, and march along with the store waggons, both as a guard, and to give their assistance in case a waggon should break down.

MATT, in a ship, rope-yarn, junk, &c. beat flat and interwoven; used in order to preserve the yards from galling or rubbing in hoisting or lowering them.

MATTER, in physiology, whatever is extended and capable of making resistance: hence, because all bodies, whether solid or fluid, are extended, and do resist, we conclude that they are material, or made up of matter. That matter is one and the same thing in all bodies, and that all the variety we observe arises from the various forms and shapes it puts on, seems very probable, and may be concluded from a general observation of the procedure of nature in the generation and destruction of

bodies. Thus, for instance, water, rarified by heat, becomes vapour; great collections of vapours form clouds; these condensed descend in the form of hail or rain; part of this collected on the earth constitutes rivers; another part mixing with the earth enters into the roots of plants, and supplies matter to, and expands itself into various species of vegetables. In each vegetable it appears in one shape in the root, another in the stalk, another in the flowers, another in the seeds, &c. From hence various bodies proceed; from the oak, houses, ships, &c. from hemp and flax we have thread; from thence our various kinds of linen; from thence garments; these degenerate into rags, which receive from the mill the various forms of paper; hence our books.

According to Sir Isaac Newton, it seems highly probable, that God in the beginning formed matter into solid, massy, impenetrable, moveable particles, or atoms, of such sizes and figures, and with such other properties, and in such proportion to space, as most conduced to the end for which he formed them; and that these primitive particles being solids, are incomparably harder than any porous bodies compounded of them, even so hard as never to wear or break in pieces; no ordinary power being able to divide what God himself made one in the first creation. While these particles continue entire, they may compose bodies of one and the same nature and texture in all ages; but should they wear away, or break in pieces, the nature of things depending on them may be changed. Water and earth, composed of old worn particles and fragments of particles, would not be of the same nature and texture now, with water and earth composed of entire particles in the beginning; and therefore, that nature may be lasting, the changes of corporeal things are to be placed only in the various separations and new associations of motions of these permanent particles, compound bodies being apt to break, not in the midst of solid particles, but where these particles are laid together, and only touch in a few points.

Dr. Berkeley, argues against the existence of matter itself; and endeavours to prove that it is a mere *ens rationis*, and has no existence out of the mind. Some late philosophers have advanced a new hypothesis concerning the nature and essential properties of matter.

The first of these who suggested, or at least published an account of this hypothesis, was M. Boscovich, in his "Theoria Philosophiæ Naturalis." He supposes, that matter is not impenetrable, but that it consists of physical points only, endued with powers of attraction and repulsion, taking place at different distances, that is, surrounded with various spheres of attraction and repulsion; in the same manner as solid matter is generally supposed to be. Provided therefore that any body move with a sufficient degree of velocity, or have sufficient momentum to overcome any power of repulsion that it may meet with, it will find no difficulty in making its way through any body whatever. If the velocity of such a body in motion be sufficiently great, Boscovich contends, that the particles of any body through which it passes, will not even be moved out of their place by it.

With a degree of velocity something less than this, they will be considerably agitated, and ignition might perhaps be the consequence, though the progress of the body in motion would not be sensibly interrupted; and with a still less momentum it might not pass at all. Mr. Michell, Dr. Priestley, and some others of our own country, are of the same opinion. See Priestley's "History of Discoveries relating to Light," p. 390. In conformity to this hypothesis, this author maintains, that matter is not that inert substance that it has been supposed to be; that powers of attraction or repulsion are necessary to its very being, and that no part of it appears to be impenetrable to other parts. Accordingly, he defines matter to be a substance, possessed of the property of extension, and of powers of attraction or repulsion, which are not distinct from matter, and foreign to it, as it has been generally imagined, but absolutely essential to its very nature and being: so that when bodies are divested of these powers, they become nothing at all. In another place, Dr. Priestley has given a somewhat different account of matter: according to which it is only a number of centres of attraction and repulsion; or more properly of centres, not divisible, to which divine agency is directed; and as sensation and thought are not incompatible with these powers, solidity, or impenetrability, and consequently a vis inertiæ only having been thought repugnant to them, he maintains, that we have no reason to suppose that

here are in man two substances absolutely distinct from each other. See "Disquisitions on Matter and Spirit."

But Dr. Price, in a correspondence with Dr. Priestley, published under the title of "A Free Discussion of the Doctrines of Materialism and Philosophical Necessity," 1778, has suggested a variety of unanswerable objections against this hypothesis of the penetrability of matter, and against the conclusions that are drawn from it. The vis inertiæ of matter, he says, is the foundation of all that is demonstrated by natural philosophers concerning the laws of the collision of bodies. This, in particular, is the foundation of Newton's philosophy, and especially of his three laws of motion. Solid matter has the power of acting on other matter by impulse; and this is the only way in which it is capable of acting, by any action that is properly its own. If it be said, that one particle of matter can act upon another without contact and impulse, or that matter can, by its own proper agency, attract or repel other matter which is at a distance from it, then a maxim hitherto universally received must be false, that "nothing can act where it is not." Newton, in his letters to Bentley, calls the notion, that matter possesses an innate power of attraction, or that it can act upon matter at a distance, and attract and repel by its own agency, an absurdity into which he thought no one could possibly fall. And in another place he expressly disclaims the notion of innate gravity, and has taken pains to shew that he did not take it to be an essential property of bodies. By the same kind of reasoning pursued, it must appear, that matter has not the power of attracting and repelling; that this power is the power of some foreign cause, acting upon matter according to stated laws; and consequently that attraction and repulsion, not being actions, much less inherent qualities of matter, as such it ought not to be defined by them. And if matter has no other property, as Dr. Priestley asserts, than the power of attracting and repelling, it must be a non-entity; because this is a property that cannot belong to it. Besides, all power is the power of something; and yet if matter is nothing but this power, it must be the power of nothing; and the very idea of it is a contradiction.

MATTHIOLA, in botany, so named from Pietro Andrea Matthiolus, the famous botanist, a genus of the Pentandria Monogynia class and order. Natural order of Rubiaceæ, Jussieu. Essential character: calyx entire; corolla tubular, superior, undivided; drupe with a globular nucleus. There is but one species, viz. M. scabra, a native of America.

MATTUSCHKÆA, in botany, a genus of the Tetrandria Monogynia class and order. Essential character: calyx four-parted, with linear leaflets; corolla one-petalled, with a long tube and four-cleft border; germ superior, four-cleft; seeds four, naked. There is but one species, viz. M. hirsuta, found in Guiana.

MAUNDY *Thursday*, is the Thursday in Passion Week, which was called Maunday or Mandate Thursday, from the command which our Saviour gave his apostles to commemorate him in the Lord's Supper, which he this day instituted; or from the new commandment which he gave them to love one another, after he had washed their feet as a token of his love to them. Our Saviour's humility in washing his disciples feet, is commemorated on this day by most christian kings; who wash the feet of a certain number of poor people, not indeed with their own royal hands, but by the hands of their lord almoner, or some other deputy.

MAUPERTUIS (Peter Louis Morceau de), a celebrated French mathematician and philosopher, was born at St. Malo in 1698, and was there privately educated till he attained his sixteenth year, when he was placed under the celebrated professor of philosophy, M. Le Blond, in the college of La Marche, at Paris; while M. Guisnée, of the Academy of Sciences, was his instructor in mathematics.

For this science he soon discovered a strong inclination, and particularly for geometry. He likewise practised instrumental music, in his early years, with great success; but fixed on no profession till he was twenty, when he entered into the army; in which he remained about five years, during which time he pursued his mathematical studies with great vigour; and it was soon remarked by M. Freret, and other academicians, that nothing but mathematics could satisfy his active soul and unbounded thirst for knowledge.

In the year 1723, he was received into the Royal Academy of Sciences, and read his first performance, which was a memoir upon the construction and form of musical instruments. During the first years of his admission, he did not wholly confine his attention to mathematics; he dipped into natu-

ral philosophy, and discovered great knowledge and dexterity, in observations and experiments upon animals.

If the custom of travelling into remote countries, like the sages of antiquity, in order to be initiated into the learned mysteries of those times, had still subsisted, no one would have conformed to it with more eagerness than Maupertuis. His first gratification of this passion was to visit the country which had given birth to Newton; and during his residence at London he became as zealous an admirer and follower of that philosopher as any of his own countrymen. His next excursion was to Basil in Switzerland, where he formed a friendship with the celebrated John Bernoulli and his family, which continued till his death. At his return to Paris, he applied himself to his favourite studies with greater zeal than ever. And how well he fulfilled the duties of an academician, may be seen by running over the memoirs of the academy from the year 1724 to 1744; where it appears he was neither idle, nor occupied by objects of small importance. The most sublime questions in the mathematical sciences, received from his hand that elegance, clearness, and precision, so remarkable in all his writings.

In the year 1736, he was sent to the polar circle, to measure a degree of the meridian, in order to ascertain the figure of the earth; in which expedition he was accompanied by Messrs. Clairault, Camus, Monnier, Outhier, and Celsus, the celebrated professor of astronomy at Upsal. This business rendered him so famous, that on his return he was admitted a member of almost every academy in Europe.

In the year 1740, Maupertuis had an invitation from the King of Prussia to go to Berlin; which was too flattering to be refused. His rank among men of letters had not wholly effaced his love for his profession, that of arms. He followed the King to the field, but at the battle of Molwitz was deprived of the pleasure of being present, when victory declared in favour of his royal patron, by a singular kind of adventure. His horse during the heat of the action running away with him, he fell into the hands of the enemy; and was at first but roughly treated by the Austrian Hussars, to whom he could not make himself known for want of language; but being carried prisoner to Vienna, he received such honours from the Emperor as never were effaced from his memory. Maupertuis lamented very much the loss of a watch of Mr. Graham's the celebrated English artist, which they had taken from him; the Emperor who happened to have another by the same artist, but enriched with diamonds, presented it to him, saying, "The Hussars meant only to jest with you, they have sent me your watch, and I return it to you."

He went soon after to Berlin, but as the reform of the academy which the King of Prussia then meditated was not yet mature, he repaired to Paris, where his affairs called him, and was chosen, in 1742, director of the Academy of Sciences. In 1743, he was received into the French Academy, which was the first instance of the same person being a member of both the academies at Paris at the same time. Maupertuis again assumed the soldier at the siege of Fribourg, and was pitched upon by Marshal Coigny and the Count d'Argenson, to carry the news to the French King of the surrender of that citadel.

Maupertuis returned to Berlin in the year 1744, when a marriage was negociated and brought about, by the good offices of the Queen mother, between our author and Mademoiselle de Borck, a lady of great beauty and merit, and nearly related to M. de Borck at that time minister of state. This determined him to settle at Berlin, as he was extremely attached to his new spouse, and regarded this alliance as the most fortunate circumstance of his life.

In the year 1746, Maupertuis was declared, by the King of Prussia, president of the Royal Academy of Sciences at Berlin, and soon after by the same prince was honoured with the Order of Merit. However, all these accumulated honours and advantages, so far from lessening his ardour for the sciences, seemed to furnish new allurements to labour and application. Not a day passed but he produced some new project or essay for the advancement of knowledge. Nor did he confine himself to mathematical studies only; metaphysics, chemistry, botany, polite literature, all shared his attention, and contributed to his fame. At the same time he had, it seems, a strange inquietude of spirit, with a dark atrabilaire humour, which rendered him miserable amidst honours and pleasures. Such a temperament did not promise a pacific life; and he was in fact engaged in several quarrels. One of these was with Kœnig, the professor of philosophy at Franeker, and another more terrible with Voltaire. Maupertuis had inserted in the volume of memoirs of the academy of Ber-

lin for 1746, a discourse upon the laws of motion; which Kœnig was not content with attacking, but attributed to Leibnitz. Maupertuis, stung with the imputation of plagiarism, engaged the academy of Berlin to call upon him for his proof; which Kœnig failing to produce, his name was struck out of the academy, of which he was a member.

Several pamphlets were the consequence of this measure; and Voltaire, for some reason or other, engaged in the quarrel against Maupertuis. We say, for some reason or other, because Maupertuis and Voltaire were apparently upon the most amicable terms; and the latter respected the former as his master in the mathematics. Voltaire, upon this occasion, exerted all his wit and satire against him; and upon the whole was so much transported beyond what was thought right, that he found it expedient, in 1753, to quit the court of Prussia.

Our philosopher's constitution had long been considerably impaired by the great fatigues of various kinds in which his active mind had involved him; though from the amazing hardships he had undergone, in his northern expedition, most of his bodily sufferings may be traced. The intense sharpness of the air could only be supported by means of strong liquors; which helped but to lacerate his lungs, and to bring on a spitting of blood, which began at least twelve years before he died. Yet still his mind seemed to enjoy the greatest vigour; for the best of his writings were produced, and most sublime ideas developed, during the time of his confinement by sickness, when he was unable to occupy his presidial chair at the academy. He took several journies to St. Malo, during the last years of his life, for the recovery of his health; and though he always received benefit by breathing his native air, yet still upon his return to Berlin, his disorder likewise returned with greater violence.

His last journey into France was undertaken in the year 1757; when he was obliged, soon after his arrival there, to quit his favourite retreat at St. Malo, on account of the danger and confusion which that town was thrown into by the arrival of the English in its neighbourhood. From thence he went to Bourdeaux, hoping there to meet with a neutral ship to carry him to Hamburgh, in his way back to Berlin; but being disappointed in that hope, he went to Toulouse, where he remained seven months. He had then thoughts of going to Italy, in hopes a milder climate would restore him to health; but finding himself grow worse, he rather inclined towards Germany, and went to Neufchatel, where for three months, he enjoyed the conversation of Lord Marischal, with whom he had formerly been much connected. At length he arrived at Basil, Oct. 16, 1758, where he was received by his friend Bernoulli and his family with the utmost tenderness and affection. He at first found himself much better here than he had been at Neufchatel; but this amendment was of short duration; for as the winter approached his disorder returned, accompanied by new and more alarming symptoms. He languished here many months, during which he was attended by M. de la Condamine, and died in 1759, at 61 years of age.

The works which he published were collected into 4 vols. 8vo. published at Lyons in 1756, where also a new and elegant edition was printed in 1768. These contain the following works: 1. Essay on Cosmology.—2. Discourse on the different Figures of the Stars.—3. Essay on Moral Philosophy.—4. Philosophical Reflections upon the Origin of Languages, and the Signification of Words.—5. Animal Physics, concerning Generation, &c.—6. System of Nature, or the Formation of Bodies.—7. Letters on various Subjects.—8. On the Progress of the Sciences.—9. Elements of Geography.—10. Account of the Expedition to the Polar Circle, for determining the Figure of the Earth; or the Measure of the Earth at the Polar Circle.—11. Account of a Journey into the Heart of Lapland, to search for an ancient Monument.—12. On the Comet of 1742.—13. Various Academical Discourses, pronounced in the French and Prussian Academies.—14. Dissertation upon Languages.—15. Agreement of the different Laws of Nature, which have hitherto appeared incompatible.—16. Upon the Laws of Motion.—17. Upon the Laws of Rest.—18. Nautical Astronomy.—19. On the Parallax of the Moon.—20. Operations for determining the Figure of the Earth, and the Variations of Gravity.—21. Measure of a Degree of the Meridian at the Polar Circle.

Besides these works, Maupertuis was author of a great multitude of interesting papers, particularly those printed in the Memoirs of the Paris and Berlin Academies, far too numerous here to mention, *viz.* in the Memoirs of the Academy at Paris from the year 1724 to 1749; and in those of the

Academy of Berlin, from the year 1746 to 1756.

MAURITIA, in botany, belonging to the App. Palmæ, and natural order of Palms. Essential character: male in an oblong sessile ament; calyx one-leafed, cup-shaped, entire; corolla one-petalled, with a short tube, and a three-parted border; filaments six. There is but one species, *viz.* M. flexuosa, a native of the woods of Surinam.

MAXILLA, the jaws, or those parts of an animal in which the teeth are set.

MAXIM, an established proposition or principle, in which sense it denotes much the same with axiom. See AXIOM.

Maxims are a kind of propositions, which have passed for principles of science, and which, being self evident, have been by some supposed innate.

MAXIMUM, in mathematics, denotes the greatest state or quantity attainable in a given case, or the greatest value of a variable quantity; hence it stands opposed to the minimum, which is the least possible quantity in any case. Thus in the expression $a^2 - bx$, where a and b are constant, and x variable, the value of the expression will increase as bx or x diminishes, and it will be greatest, or a maximum, when x is least, or $= 0$. The expression $a^2 - \frac{b}{x}$ increases as $\frac{b}{x}$ diminishes, that is as x increases, and it will be a maximum when x is infinite. If along the diameter, K Z (Plate X, Miscel. fig. 4.) of a circle, a perpendicular ordinate, L M, be conceived to move from K to Z, it increases till it arrive at the centre, where it is greatest, and from thence it decreases till it vanishes at Z. Some quantities continually increase, and have no maximum, unless what is infinite, as the ordinates of a parabola: some continually decrease, so that their minimum state is nothing, as the ordinates to the asymptotes of the hyperbola. Others increase to a certain point, which is their maximum, and then decrease again; as the ordinates of a circle. Others admit of several maxima and minima; as the ordinates of the curve (fig. 5.) $a\,b\,c\,d\,e$, &c. where b and d are the maxima, and $a\,c\,e$ are minima: hence it is easy to imagine of other variable quantities, exhibited by the ordinates of other kinds of curves. We have, under the article FLUXIONS, given some examples on the maxima and minima of quantities, we shall in this place point out another mode of performing the same thing, with an example or two. The rule is this:

"Find two values of an ordinate expressed in terms of the abscissa: put those two values equal to each other, striking out the parts that are common to both, and dividing all the remaining terms by the difference between the abscissas, which will be a common factor in them: then supposing the abscissas to become equal, that the equal ordinates may concur in the maximum or minimum, that difference will vanish, as well as all the terms of the equation that include it, and therefore striking those terms out of the equation, the remaining terms will give the value of the abscissa corresponding to the maximum."

1. Suppose it were required to find the greatest ordinate in a semicircle K M Q Z. Let K Z $= a$: K L the abscissa $= x$: L M the ordinate $= y$: hence L Z $= a - x$, and by the nature of the circle K L $\times$ L Z $=$ L M^2, that is $ax - x^2 = y^2$.

Let the abscissa K P $= x \times d$, d being equal to L P; the ordinate P Q $=$ L M $= y$. K P $\times$ P Z $=$ P Q^2, or $\overline{x+d} \times \overline{a-x-d} = ax - x^2 - 2dx + ad - d^2 = y^2 = ax - x^2$; therefore $-2dx + ad - d^2 = 0$: or $ad = 2dx + d^2$, or $a = 2x + d$, an equation derived from the equality of the two ordinates: now, by bringing the two equal ordinates together, or making the two abscissas equal, their difference, d, vanishes, and $a = 2x$, or $x = \frac{a}{2} =$ K N, the value of the abscissa K N, when N O is a maximum, that is, the greatest ordinate bisects the diameter.

2. Let it be required to divide a given line into two such parts, that the one drawn into the square of the other may be the greatest possible. Let the given line be a; one part x, of course the other part $a - x$; and therefore by the terms of the question $x^2 \times \overline{a-x} = ax^2 - x^3$ is the product of one part by the square of the other. For the sake of comparison, let one part be $x + d$, then the other part will be $a - x - d$ and $\overline{x+d}|^2 \times \overline{a-x-d} = ax^2 - x^3 - 3dx^2 + \overline{2ad - 3d^2} \times x + ad^2 - d^3 =$ (as before) $ax^2 - x^3$: therefore, $-3dx^2 + \overline{2ad - 3d^2} \times x + ad^2 - d^3$, divided by d, gives $-3x^2 + \overline{2a - 3d} \times x + ad - d^2$, and now striking out the terms that have d in them, we get $-3x^2 + 2ax = 0$, and $3x = 2a$, and $x = \frac{2}{3}a$; that is, the given line must be divided into two parts, in the ratio of 3 to 2.

MAXIMUS (Tyrius), in biography, a celebrated philosopher and elegant writer in the second century, was a native of Tyre, in Phœnicia, whence he took his name. Suidas says, that he lived under the Emperor Commodus, while Eusebius and Syncellus place him under Antoninus Pius. If we suppose that he flourished under Antoninus, and lived to the time of the first-mentioned Emperor, the accounts of those chronologers may be reconciled. According to some writers, he came to Rome in the year 146, where the Emperor Marcus Aurelius gave him many tokens of his esteem, and placed himself under his instruction; but it is more probable, that the preceptor of whom that prince speaks, under the name of Maximus, was some other philosopher, of the Stoical sect. Our Maximus appears, from his writings, to have adopted the principles of the Platonic school, with some tendency towards scepticism. Forty-one of his "Dissertations" on various philosophical topics are still extant, and display the most captivating powers of eloquence. The first Latin version of them was published at Basil, by Cosmo Pazzi, Archbishop of Florence, in 1519, folio; and Henry Stevens first printed the original Greek, at Paris, in 1557, 8vo. to which he added Pazzi's version, with numerous alterations and corrections. In 1607, the learned Daniel Heinsius published an edition of them at Leyden, in Greek and Latin, 8vo.; the version being his own, and illustrated with notes. Of this edition our countryman, Dr. John Davies, gave a new impression from the Cambridge press, in 1703, 8vo. with corrections, additional notes, and two useful indexes.

MAYER (Tobias), in biography, a very able German astronomer and mechanic in the eighteenth century, was born at Marspach, in the duchy of Wirtemberg, in the year 1723. His father was an ingenious civil-engineer, who particularly excelled in hydraulics; and young Tobias, who was fond of observing him while at work, displayed an early inquisitiveness concerning such ingenious pursuits, and from the age of four years began to design machines with the greatest dexterity and justness. The death of his father, however, whom he lost when very young, probably prevented him from being educated to that employment. Possessing but scanty means for obtaining assistance in his studies, he was obliged to rely on his own energies, by which he made himself a proficient in mathematical learning, and became qualified to be an able instructor of others. While thus occupied, he also assiduously cultivated an acquaintance with classical and polite literature, and learned to write the Latin tongue with elegance. So well established was his reputation when he had attained to his eight-and-twentieth year, that the university of Gottingen nominated him to the chair of mathematical professor; and not long afterwards he was admitted a member of the Royal Society in that town. From this time, every year of his short, but glorious life, was distinguished by some considerable discoveries in geometry or astronomy. He invented several useful instruments for the more commodious and exact measurement of angles on a plane. He corrected many errors in practical geometry, tracing them to their origin, in the refractions occasioned by terrestrial objects. Afterwards he particularly applied himself to study the theory of the moon, its appearances, the question of its atmosphere, and the reciprocal actions of the sun, earth, and moon upon each other. He then extended his observations to the planet Mars, and the fixed stars; determining with greater exactness than before the places of the latter, and ascertaining that, though commonly denominated fixed, they possess a certain degree of motion relative to their respective systems. Towards the end of his life the magnetic needle engaged his attention, to which he assigned more certain laws than those before received. To these various enquiries and observations he applied with such indefatigable assiduity, that he died exhausted and worn out by his labours in 1762, when only 39 years of age. His table of refractions, deduced from his astronomical observations, agrees very nicely with that of Dr. Bradley; and his theory of the moon, and astronomical tables and precepts, were so well received, that they were rewarded by the English Board of Longitude with the premium of 3,000*l.* which sum was paid to his widow after his decease. These tables and precepts were published by the board in the year 1770. The principal works which he gave himself to the public were, "A New and General Method of resolving all Geometrical Problems, by means of Geometrical Lines," 1741, 8vo. in German. "A Mathematical Atlas, in which all the Mathematical Sciences are comprised in sixty Tables," 1748, folio, in German. "A Description of a Lunar Globe, constructed by the Cosmographical Society of Nuremberg, from new Observations," 1750, 4to. also in German. Several exact "Maps;" and some valuable papers in the Memoirs of the Royal

Society of Gottingen. The first volume of his works was published at that place in 1775, in folio.

MAYOR, is the chief magistrate in a city or town corporate, who has under him aldermen, common-council, and officers of different kinds. Their authority is different, according to different charters; but they are always magistrates within the corporation.

MEAN, a middle state between two extremes: thus we have an arithmetical mean, geometrical mean, mean distance, mean motion, &c. An arithmetical mean is half the sum of the extremes: thus, if 2 and 12 be the extremes, then $\frac{2+12}{2}=7$ is the arithmetical mean: likewise between a and b it is $\frac{a+b}{2}$. Geometrical mean, usually called a mean proportional, is the square root of the product of the two extremes: therefore, to find a mean proportional between two given extremes, multiply these together, and extract the square root of the product. Thus, a mean proportional between 6 and 24 is 12; for $\sqrt{6 \times 24} = \sqrt{144} = 12$: and between x and y it is $\sqrt{xy}$. The arithmetical mean is greater than the geometrical mean between the same two extremes: thus, between 6 and 24 the geometrical mean is 12; but the arithmetical mean is $\frac{6+24}{2}=15$. Or, generally, let a be the greater and b the less; then $\frac{a+b}{2}$ is greater than $\sqrt{ab}$, or multiplying both by 2; $a+b$ is greater $2\sqrt{ab}$: for squaring both we have $a^2+2ab+b^2$ greater than $4ab$; for take away $4ab$ and $a^2-2ab+b^2$ greater than 0: or $\overline{a-b}|^2$ greater than 0 by the supposition.

To find a mean proportional, geometrically, between two given right lines, a and b, (Plate Miscel. X. fig. 6.) join the two given lines together at x in one continued line, ab; upon the diameter ab describe a semicircle azb, and erect the perpendicular zx, which will be the required mean proportional; for, by a well-known theorem in geometry, $ax \times xb$ is equal to xz^2, or $ax : xz :: xz : xb$.

To find two mean proportionals between two given extremes: "Multiply each extreme by the square of the other, *viz.* the greater extreme by the square of the less, and the less extreme by the square of the greater; then extract the cube root out of each product, and the two roots will be the two mean proportionals sought." Thus the two mean proportionals between a and b are $\sqrt[3]{a^2b}$ and $\sqrt[3]{ab^2}$: or between 2 and 16 the mean proportionals are $\sqrt[3]{64}$, and $\sqrt[3]{512} = 4$ and 8.

MEAN *harmonical.* See HARMONICAL *proportion.*

MEAN *distance of a planet from the sun,* in astronomy, is the right line drawn from the sun to the extremity of the conjugate axis of the ellipsis the planet moves in; and this is equal to the semi-transverse axis, and is so called, because it is a mean between the planet's greatest and least distance from the sun. See DISTANCE.

MEAN *motion,* in astronomy, that whereby a planet is supposed to move equally in its orbit, and is always proportional to the time. See MOTION.

MEASLES. See MEDICINE.

MEASURE signifies any given quantity, estimated as one, to which the proportion of other similar quantities may be expressed.

Measure is classed under a variety of heads, of which the following are illustrations.

MEASURE *of velocity,* is the interval of space between two points, regularly passed through by a substance in constant and uniform motion, within a certain period of time.

MEASURE *of a solid,* is a cubic inch, foot, or yard; in other words, a cube, the side of which is an inch, a foot, or a yard.

MEASURE *of a line,* is the extension of a right line at pleasure, which is to be considered as unity; for instance, an inch, a foot, or a yard.

MEASURE *of a figure,* or a surface perfectly level, thence called a plane surface, is a square inch, foot, or yard. This square is termed the measuring unit, because the side is an inch, a foot, a yard, or any other determinate extent.

MEASURE *of a certain portion or quantity of matter,* is its weight.

MEASURE *of a number,* applies thus: 2 is the measure of 4, 3 of 6, &c.; in fact, it is any number which divides without a remainder.

It has long been wished by the learned, that an universal measure, secured by penalties in an unalterable state, had hitherto been, or may hereafter be adopted, which would prove of incalculable advantage to mankind in their philosophical and even less exalted pursuits. Prejudices are,

however, far too numerous and powerful to be easily overcome, or removed, in matters of infinitely less moment. We cannot, therefore, entertain the slightest hope that national partiality will be subdued in every quarter of the globe, so as to produce a general resignation of favourite methods, in order to adopt a new one recommended by a congress of philosophers, which it would be equally difficult to assemble, or prevail upon to agree to any plan unanimously. The theories of eminent men on this subject are useful, and deserve attention, as they may suggest improvements of great importance. Huygens proposed the length of a pendulum that should vibrate seconds, to be measured from the point of suspension to that of oscillation. The third part of this pendulum he termed a horary foot, and such he recommended should be the standard by which the measure of every foot in Europe might be regulated. Admitting his plan to be worthy of adoption, and an experiment made, it appears that the Paris foot would bear a proportion to the horary foot of 864 to 881, which is demonstrated in this manner: The length of three Paris feet is 864 half lines, and that of a pendulum vibrating seconds consists of 881 half lines. The principal objection to this ingenious suggestion of Huygens is founded on the assumption that the action of gravity is the same in all parts of the globe, which is certainly not the case; consequently, instead of its serving universally, it would be useful only in those places which lie under the same parallel of latitude. Thus, if each different latitude had its foot equal to the proposed third part of the pendulum vibrating seconds there, any given latitude must have a different length for the foot. Exclusive of this objection, there would be a second proceeding from the difficulty attending the exact measurement between the centres of motion and oscillation, which is such, that it is highly probable no two persons would agree in their accounts of the space.

Many attempts and expedients were suggested after the rejection of the above plan, with similar want of success. This circumstance did not escape the notice of the Society for the Encouragement of Arts, Manufactures, and Commerce, the officers of which, with a commendable zeal, advertized a premium of one hundred guineas, or a gold medal, as a reward to those who would propose the approved means "for obtaining invariable standards for weights and measures, communicable at all times and to all nations." This invitation produced a communication from Mr. Hatton, in 1779, in which he proposed the application of a moveable point of suspension to one and the same pendulum, and by this means he intended to accomplish the full effect of two, the difference in the lengths of which was the desired measure.

The ideas of Mr. Hatton were approved by the ingenious Whitehurst, who improved upon them, and invented some very curious and excellent machinery; besides which, he published, eight years after, a work entitled "An Attempt towards obtaining invariable Measures of Length, Capacity, and Weight, from the Mensuration of Time," &c. Mr. Whitehurst thought it convenient and proper for attaining this most desirable end, to endeavour to obtain a measure of the greatest convenient length from two pendulums, the vibrations of which are in the ratio of two to one, and of lengths agreeing with the English standard in whole numbers.

To explain our philosopher's intentions more fully, let us admit the supposition that the length of a pendulum vibrating seconds in the latitude of London is 39.2 inches; the length of one vibrating 42 times in a minute amounts to 80 inches; by the same unerring rule, another vibrating 84 times in a minute must be 20 inches: the difference resulting from these data is 60 inches and his proposed standard measure. Pursuing his experiments to the very acme of perfection, he found the variation in the length of the two pendulums to be 59.892 inches, instead of 60, arising from an error in the assumed length of the seconds' pendulum.

It is generally admitted, that Mr. Whitehurst has succeeded in his design, and demonstrated to the learned how an invariable standard may at any time be found for the same latitude. Besides this discovery, the world is indebted to him for the accurate ascertaining of a fact of very considerable importance in natural philosophy. A person who wrote with ability on this point observes, with respect to the fact just mentioned, "The difference between the lengths of the rods of two pendulums, whose vibrations are known, is a datum from which may be derived the true lengths of pendulums, the spaces through which heavy bodies fall in a given time, with many other particulars relative to the doctrine of gravitation, the figure of the earth," &c. Mr. Whitehurst perceived from this experiment, that the length of a second's pendulum vibrating in a

circular arc of 3° 20′, is very nearly 39.119; but performing the same motion in the arc of a cycloid, the result would be 39.136 inches; consequently, weighty substances will descend in the first second after they are detached from their support nearly 16.094 feet, or 16.1¼ inch.

Dr. Young, to whom we acknowledge ourselves indebted for many of the following particulars, has given an excellent compressed table of measures and standards, in his recent valuable work, "A Course of Lectures on Natural Philosophy," &c. from which we find, that the English yard is said to have been derived from the length of the arm of Henry I. in the year 1101; that Graham asserts the length of the pendulum vibrating seconds accurately is equal to 39.13 inches; that Bird's parliamentary standard is admitted to be of the greatest authority, and that it agrees nearly with the scales of Shuckburgh and Pictet, made by Troughton. The standard of the Royal Society by Graham exceeds that of Bird's in length about 1000th part of an inch, but it is not quite uniform throughout its length. The standard in the Exchequer is about .0075 inch shorter than the yard of the Royal Society. General Roy used a scale of Sisson, divided by Bird, and found it to agree exactly with the Tower standard on the Royal Society's scale. Sir George Shuckburgh, adopting Troughton's scales for the standard, found the original Tower standard 36.004; the yard E. on the Royal Society's scale by Graham 36.0013 inches; the yard Exchequer of the same scale 35.9933; Roy's scale 36.00036; the Royal Society's scale by Bird 35.99955; Bird's parliamentary standard of 1758, 36.00023. The English have employed and adjusted their standards at the temperature of 62° of Fahrenheit's thermometer, and the French at the freezing point of water. The French metre is 39.37100 English inches, and the ten millionth part of the quadrant of the meridian. The same measure contains 36.9413 French inches, or 3 feet 11.296 lines. Hence, says the Doctor, the French toise of 72 inches is equal to 76.736 English inches. One of Lalande's standards measured by Dr. Maskelyne was 76.732, the other 76.736. In latitude 45°, a pendulum of the length of a metre would perform in a vacuum 86116.5 vibrations in a day. The length of the second pendulum is 993827 at Paris.

The French National Institute of Sciences and Arts have turned their attention to this subject, and in the month of Nivose, in the year 1801, a member read a report from a committee, founded on the comparison of the standard metre of the Institute with the English foot. And M. Pictet, professor of natural philosophy at Geneva, exhibited to the class, in the month of Vendemiaire, a collection of the most interesting objects, which he had collected in England, relating to arts and sciences. One of the number was a standard of the English linear measure, which was of brass, 49 inches in length, and neatly divided by engraved lines into tenths of an inch. This standard was made for the exhibitor by Troughton, a resident in London, who has deservedly acquired the reputation of dividing instruments with the utmost accuracy, which was compared with another made by the same artist for Sir George Shuckburgh, when it was ascertained satisfactorily, that the variations between them did not amount to more than the difference between the divisions of each; in other words, the variation was almost imperceptible. Arguing from this circumstance, the standard may be considered as identical with that described by Sir George Shuckburgh in the Philosophical Transactions for 1798.

Another excellent instrument, constructed by Mr. Troughton, and shewn at the same time by M. Pictet, was a comparer, calculated to ascertain minute variations between measures. This instrument "consists of two microscopes, with cross wires, placed in a vertical situation, the surface of the scale being horizontal, and fixed at proper distances upon a metallic rod. One of them remains stationary at one end of the scale, the other is occasionally fixed near to the other end; and its cross wires are moveable by means of a screw, describing in its revolution $\frac{1}{100}$th of an inch, and furnished with a circular index, dividing each turn into 100 parts; so that having two lengths, which differ only one-tenth of an inch from each other, we may determine their difference in ten-thousandths of an inch. The wires are placed obliquely with respect to the scale, so that the line of division must bisect the acute angle which they form, in order to coincide with their intersection." An instrument similar to that thus described, and made by Ramsden, for measuring the expansion of metals, was described by General Roy in the seventy-fifth volume of the Royal Transactions.

M. Pictet, influenced by a desire of advancing science, made an offer to the class the use of the standard and the micrometer

for the purpose of determining the comparative length of the metre and the English foot: the offer was gratefully accepted by the Society, and Messieurs Legendre, Machain, and Prony, were appointed to assist M. Pictet in making the proposed comparison of their standard metre of platina and the measure just mentioned. The first assembling of this committee was on the 21st of October, of the same year, at the mansion of M. Lenoir. Upon commencing their operations, they found some difficulty arising from the different manner in which the measures were defined: the French standards were merely cut off to the length of a metre; but the English scale was graduated by lines; consequently the length of the former could not readily be taken by the microscopes, neither could the English scale be measured by the usual method adopted for making new standard metres, which is accomplished by fixing one extremity against a firm support, "and bringing the other into contact with the face of a cock, or slider, adjusted so as barely to admit the original standard between it and the fixed surface."

M. Lenoir endeavoured to remove this unfortunate impediment, by taking a piece of brass of the length of a metre, and reducing the terminations to a thin edge, which was compared by the committee with the standard metre as usual; when placed on the English scale the extremities of the brass made two parallel lines to those engraved on the scale, and thus the apparatus was capable of being seen through the microscope: by these means the standard metre of platina, and another belonging to the Institute, made of iron, were compared with the English foot; the two measures each being equal, at the temperature of melting ice, to the ten millionth part of the quadrant of the meridian. "At the temperature of 15.3° of the decimal thermometer, or 59.5° of Fahrenheit, the metre of platina was equal to 39.3775 English inches, and that of iron to 39.3788, measured on M. Pictet's scale."

It was discovered, however, that the manner employed produced results not quite satisfactory, as an uncertainty occurred through the difficulty of placing the cross wires exactly at the extreme of the brass plate, where a reflection of light took place which precluded a distinct observation whether the optical axis of the microscope was decidedly a tangent to the surface precisely at the termination. M. Prony, a member of the committee, suggested another arrangement as a remedy for this obstacle, and M. Paul, of Geneva, who was present, carried it into execution: this latter gentleman traced a perpendicular line to its length, on a small metallic ruler, the end of which he placed against a firm resistance, and the cross wires were made to agree with the line; they then interposed the standard metre between the end of the piece and the resisting substance, "and the line traced on it, which had now obviously advanced the length of the metre, was subjected to the other microscope. The microscopes, thus fixed, were transferred to the graduated scale; one of them was placed exactly over one of the divisions, and the micrometer screw was turned in order to measure the fraction, expressing the distance of the other microscope from another division."

A second comparison took place on the 26th of October, at the residence of a member of the committee; and after several satisfactory experiments, it was discovered, that at the temperature 12.75°, or 55 of Fahrenheit, the standard of platina was 39.3781, and that of iron 39.3795 English inches. The different metres being intended to be equal at the temperature of melting ice, the preceding experiments may be tried by bringing their results to the same temperature. To determine this, we have Borda's accurate trials, and the report of the committee of weights and measures on the dilatation of platina, brass, and iron, whence it appears, "that for each degree of the decimal thermometer, platina expands .00000856; iron, 00001156; and brass, 00001783: for Fahrenheit's scale these quantities become 476; 642, and 990 parts in a hundred millions. From these data we find, that, at the freezing point, the standard metre of platina was equal to 39.38280, and that of iron to 39.38265 English inches of M. Pictet's scale. The difference is less than the 500th of a line, or the 200,000th of the whole metre."

The facts obtained by all the comparisons amount to this conclusion, taking each of the measures at the temperature of melting ice, the individual standard metres are equal to the 10,000,000th part of the quadrant of the meridian, and to 39.38272 English inches of M. Pictet's scale.

It is found, upon examination of the reduction of the standards of platina and iron to the freezing point, that they vary rather less than is asserted in the report, and that

they agree "within a unit in the last place of the decimals expressing their magnitudes, or one ten thousandth of an inch." At the freezing point, the standard of platina becomes equal to 39.37380, and that of iron to 39.37370 English inches on the scale of brass at 55°, and the mean of these to 39.37100 English inches at 62°, the temperature constantly adopted in the comparison of English standards, and particularly in the recent trigonometrical operations. This result corresponds in a most surprising manner with Mr. Bird's determination of the lengths of the toises sent to Dr. Maskelyne by M. Lalande, the mean of which was 76.734 inches, consequently the metre having been proved to contain 36.9413 French inches, appears to be equal to 39.3702 English inches, or rather either 39.3694 or 39.3710; as either of the two toises may have been more correct than the other, it will therefore be perfectly safe to give the preference to that measuring 76.726 inches.

Admitting the French measurements of the arc of the meridian to be correct, the complete circumference of the globe amounts to 24855.43 English miles, and its mean diameter 7911.73.

The nineteenth volume of the Bibliothéque Britannique contains a description of Lenoir's comparer, written by M. Prony, "Its peculiarity," according to Dr. Young, "consists in the application of a bent lever, of which the shorter arm is pressed against the end of the substance to be measured, while the longer serves as an index, carrying a vernier, and pointing out on a graduated arch the divisions of a scale which by this contrivance is considerably extended in magnitude." It does not appear, at first sight, to be certain "that the difficulty of fixing the axis of the lever with perfect accuracy, and of forming a curve for the surface of the shorter arm, or of reducing the gradation of the arc to equal parts of the right line in the direction of the substance to be measured, might not in practice more than counterbalance the advantage of this mechanical amplification of the scale over the simpler optical method employed in the English instruments."

We shall conclude this article by giving the following useful tables, compressed from the work already mentioned, as the most recent and valuable authority.

ENGLISH MEASURES.

	Inches.
A foot is	12
A yard	36
A pole, or rod	198
A furlong	7920
A mile	63360
A link	7.92
A chain	792
A nail of cloth	2¼
A quarter	9
A yard	36
An ell	45
A hand	4
	Square yards.
An acre	4840

The wine gallon is fixed at 231 cubic inches by an act passed in the reign of Qneen Anne, consequently

	Cubic inches.
A pint is	28.875
A quart	57.75
A barrel	7276.5
A hogshead	14553.
A pint of country ale, or beer measure, is	35.25
A quart	70.5
A gallon	282.
A barrel, beer measure, is	10152.
——— ale ditto	9024.
——— country ditto	9588.
A hogshead, beer measure, is	15228.
——— ale ditto	13536.
——— country ditto	14382.
A pint, dry measure, is	33.6
A quart	67.2
A pottle	134.4
A gallon	268.8
A peck	537.6
A Winchester bushel	2150.42
A heaped bushel is one-third more.	
A quarter	17203.36

A wey, or load, is five quarters; and two loads make a last of wheat.

Sixty pounds is the mean weight of a bushel of wheat, 50 of barley, and 38 of oats.

Thirty-six heaped bushels make a chaldron of coals, which generally weigh about 2988 pounds.

An inch pipe, ten yards in length, contains precisely an ale gallon, weighing 10¼ pounds.

The ancient standard wine gallon of Guildhall contains 224 cubic inches.

It is imagined, that previous to the "Conquest, a cubic foot of water weighed 1000 ounces; 32 cubic feet weighed 2000 pounds, or a tun; that the same quantity was a tun of liquids; and a hogshead 8 cubic feet, or 13824 cubic inches, one 63d of which was 219.4 inches, or a gallon."

A quarter of a ton was a quarter of wheat, which weighed about 500 pounds; one

eighth of this, or a bushel, was equivalent to a cubic foot of water. A chaldron of coals weighed 2000 pounds, and was a ton.

The French, acting upon a general system of innovation during the late Revolution in that country, formed new measures, the nomenclature of which is generally disapproved of by the learned of England, and Dr. Young ventures to give them, in some degree amended, as follow:

	English inches.
Millometre	.03937
Centimetre	.39371
Decimetre	3.93710
Metre	39.37100
Decametre	393.71000
Hecatometre	3937.10000
Chiliometre	39371.00000
Myriometre	393710.00000

The metre is 1.09364 yards, or nearly 1 yard, 1½ nail, or 443.2959 lines French, or .513074 toises.

A decametre is 10 yards, 2 feet, 9.7 inches.

A hecatometre, 109 yards, 1 foot, 1 inch.

A chiliometre, 4 furlongs, 213 yards, 1 foot, 10.2 inches.

A micrometre, 6 miles, 1 furlong, 156 yards, 6 inches.

Eight chiliometres are nearly 5 miles.

An inch is .0254 metre; 2441 inches, 62 metres; 1000 feet, nearly 305 metres.

An arc, a square decametre, is 3.95 perches.

A hecatre, 2 acres, 1 rood, 35.4 perches.

	Cubic inches English.
Millilitre	.06103
Centilitre	.61028
Decilitre	6.10280
Litre, a cubic decimitre	61.02800
Decalitre	610.28000
Hecatolitre	6102.80000
Chiliolitre	61028.00000
Myriolitre	610280.00000

Two and ⅛th wine pints are about a litre; 3 wine pints are nearly 14 decilitres; a chiliolitre is one tun, 12.75 wine gallons.

3,5317 cubic feet make a decistere, a measure for fire-wood.

A stere, a cubic metre, 35.3171.

We shall now present the reader of this article with various ancient and modern measures, which were selected from the best authorities.

ANCIENT MEASURES.

Arabian foot	**1.095**
Egyptian foot	**1.421**
Egyptian stadium	730.8
Greek foot	1.009
—— phyletarian foot	1.167
Hebrew foot	1.212
—— cubit	1.817
—— sacred cubit	2.002
—— great cubit = six common cubits.	
Natural foot	.814
Roman foot	.970
——(after Titus)	.965
——(from rules)	.9672
——(from buildings)	.9681
——(from a stone)	.9696
Roman mile of Pliny	4840.5
—— of Strabo	4903.
Sicilian foot of Archimedes	.730

MODERN MEASURES.

Amsterdam foot	.927
—— ell	2.233
Antwerp foot	.940
Barcelona foot	.992
Basle foot	.944
Bavarian foot	.968
Berlin foot	.992
Bologna foot	1.244
Brabant ell in Germany	2.268
Brescia foot	1.560
Brescian braccio	2.092
Brussels foot	.902
—— greater ell	2.278
—— lesser ell	2.245
China mathematical foot	1.127
—— Imperial foot	1.051
Chinese li	606.
Constantinople foot	2.195
Copenhagen foot	1.049
Dresden foot	.929
—— ell = 2 feet	1.857
Florence foot	.995
—— braccio	1.900
Genoa palm	.812
—— canna	7.300
Geneva foot	1.919
Hamburgh foot	.933
Lisbon foot	.952
Madrid foot	.915
—— vara	3.263
Malta palm	.915
Moscow foot	.928
Naples palm	.861
—— canna	6.908
Paris foot	1.066
Paris metre	**3.281**
Rome palm	.733
—— foot	.966
—— deto ($\frac{1}{16}$ foot)	.0604
—— oncio ($\frac{1}{12}$ foot)	.0805
—— palmo	.2515
—— palmo di architettura	.7325

Rome canna di architettura	7.325
—— staiolo	4.212
—— canna dei mericanti (8 palms)	6.5365
—— braccio dei mercanti (4 palms)	2.7876
—— braccio di tessitor di tela	2.0868
—— braccio di architettura	2.561
Russian archine	2.3625
—— arschin	2.3333
—— verschuck, $\frac{1}{16}$ arschin	.1458
Stockholm foot	1.073
Turin foot	1.676
—— ras	1.958
—— trabuco	10.085
Tyrol foot	1.096
—— ell	2.639
Venice foot	1.137
—— braccio of silk	2.108
—— ell	2.089
—— braccio of cloth	2.250
Vienna foot	1.036
—— ell	2.557
—— post mile	24888.
Warsaw foot	1.169

The yoke of land, a description of measure in Austria, contains 1600 square fathoms: "1 metz, or bushel, 1.9471 cubic feet. 1 eimer = 40 kannen = 1.792 cubic feet, of Vienna; 1 fass = 10 eimer."

In Sweden, a kanne contains 106 cubic Swedish inches.

Measure, in geometry, denotes any quantity assumed as one, or unity, to which the ratio of other homogeneous or similar quantities is expressed. This definition is somewhat more agreeable to practice than that of Euclid, who defines measure, a quantity which being repeated any number of times becomes equal to another. This latter definition answers only to the idea of an arithmetical measure, or quota-part.

Measure *of an angle*, is an arch described from the vertex in any place between its legs. Hence angles are distinguished by the ratio of the arches, described from the vertex between the legs to the peripheries. Angles then are distinguished by those arches; and the arches are distinguished by their ratio to the periphery: thus an angle is said to be of so many degrees as there are in the said arch. See Angle.

Measure *of a figure*, or plane surface, is a square whose side is one inch, foot, yard, or some other determinate length. Among geometricians, it is usually a rod called a square rod, divided into ten square feet, and the square feet into ten square digits: hence square measures.

Measure *of a line*, any right line taken at pleasure, and considered as unity. The modern geometricians use a decempeda, or perch, divided into ten equal parts, called feet; the feet they subdivide into ten digits, and the digit into ten lines, &c.

Measure *of the mass, or quantity of matter*, in mechanics, is its weight; it being apparent that all the matter which coheres and moves with a body, gravitates with it, and it being found by experiment that the gravities of homogeneal bodies are in proportion to their bulks, hence, while the mass continues the same, the weight will be the same, whatever figure it put on; by which is meant its absolute weight, for as to its specific, that varies as the quantity of the surface varies.

Measure *of a number*, in arithmetic, such a number as divides another without leaving any fraction: thus 9 is a measure of 27.

Measure *of a solid*, is a cube whose side is one inch, foot, yard, or any other determinate length. In geometry, it is a cubic perch, divided into cubic feet, digits, &c.: hence cubic measures, or measures of capacity.

Measure *of velocity*, in mechanics, the space passed over by a moving body in a given time. To measure a velocity therefore, the space must be divided into as many equal parts as the time is conceived to be divided into; the quantity of space answering to such an article of time is the measure of the velocity.

Measure *for horses*, is the hand, which, by statute, contains four inches.

Measure is also used to signify the cadence and time observed in poetry, dancing, and music, to render them regular and agreeable. See Metre.

Measure, in music, the interval or space of time which the person who beats time takes between the rising and falling of his hand, in order to conduct the movement sometimes quicker and sometimes slower, according to the music or subject that is to be sung or played. See Time.

MECHANICAL, in mathematics, denotes a construction of some problem, by the assistance of instruments, as the duplicature of the cube and quadrature of the circle, in contradistinction to that which is done in an accurate and geometrical manner.

Mechanical *curve*, is a curve, according to Des Cartes, which cannot be defined by any algebraic equation; and so stands contra-distinguished from algebraic or geometrical curves.

Leibnitz and others call these mechanical curves transcendental, and dissent from Des Cartes in excluding them out of geometry. Leibnitz found a new kind of transcendental equations, whereby these curves are defined; but they do not continue constantly the same in all points of the curve, as algebraic ones do.

MECHANICS, is the science which treats of the laws of the equilibrium and motion of solid bodies; of the forces by which bodies, whether animate or inanimate, may be made to act upon one another; and of the means by which these may be increased, so as to overcome such as are most powerful. As this science is closely connected with the arts of life, and particularly with those which existed even in the rudest ages of society, the construction of machines must have been practised long before the theory upon which their principles depend could have been understood. Hence we find in use among the ancients, the lever, the pulley, the crane, the capstan, and many other simple machines, at a period when mechanics, as a science, were unknown. In the remains of Egyptian architecture are beheld the most surprising marks of mechanical genius. The elevation of immense and ponderous masses of stone to the tops of their stupendous fabrics, must have required an accumulation of mechanical power, which is not in the possession of modern architects. We are indebted to Archimedes for the foundation of this science: he demonstrated, that when a balance with unequal arms is in equilibrio, by means of two weights in its opposite scales, these weights must be reciprocally proportional to the arms of the balance. From this general principle the mathematician might have deduced all the other properties of the lever, but he did not follow the discovery through all its consequences. In demonstrating the leading property of the lever, he lays it down as an axiom, that if the two arms of the balance are equal, the weights must be equal, to give an equilibrium. Reflecting on the construction of the balance, which moved upon a fulcrum, he perceived that the two weights exerted the same pressure on the fulcrum as if they had both rested on it. He then advanced another step, and considered the sum of these two weights as combined with a third, and then the sum of the three, with a fourth, and so on, and perceived that in every such combination the fulcrum must support their united weight; and, therefore, that there is in every combination of bodies, and in every single body which may be considered as made up of a number of lesser bodies, a centre of pressure or gravity. This discovery Archimedes applied to particular cases, and pointed out the method of finding the centre of gravity of plane surfaces, whether bounded by a parallellogram, a triangle, a trapesium, or a parabola. See CENTRE *of gravity*.

Galileo, towards the close of the sixteenth century, made many important discoveries on this subject. In a small treatise on statics, he proved that it required an equal power to raise two different bodies to altitudes, in the inverse ratio of their weights, or that the same power is requisite to raise ten pounds to the height of one hundred feet, and twenty pounds fifty feet. It is impossible for us to follow this great man in all his discoveries. In his works, which were published early in the seventeenth century, he discusses the doctrine of equable motions in various theorems, containing the different relations between the velocity of the moving body, the space which it describes, and the time employed in its description. He treats also of accelerated motion, considers all bodies as heavy, and composed of heavy parts, and infers that the total weight of the body is proportional to the number of the particles of which it is composed. On this subject he reasons in the following manner: "As the weight of a body is a power always the same in quantity, and as it constantly acts without interruption, the body must be continually receiving from it equal impulses in equal and successive instants of time. When the body is prevented from falling, by being placed on a table, its weight is incessantly impelling it downwards; but these impulses are destroyed by the resistance of the table, which prevents it from yielding to them. But where the body falls freely, the impulses which it perpetually receives are perpetually accumulating, and remain in the body unchanged in every respect, except the diminution which they experience from the resistance of the air: hence it follows, that a body falling freely is uniformly accelerated, or receives equal increments of velocity in equal times. He then demonstrated that the time in which any space is described by a motion uniformly accelerated from rest, is equal to the time in which the same space would be described by an uniform equable motion, with half the final velocity of the accelerated motion,

and that in every motion uniformly accelerated from rest, the spaces described are in the duplicate ratio of the times of description: after this he applied the doctrine to the ascent and descent of bodies on inclined planes. For a more particular account we may refer to Dr. Keil's "Physics." Under the articles CENTRE *of gravity*, DYNAMICS, ELASTICITY, FORCE, GRAVITATION, MOTION, &c. will be found much relating to the doctrine of mechanics; we shall therefore in this place chiefly treat of the mechanical powers, which are usually reckoned six in number: *viz.* the lever; the wheel and axis, or, as it is frequently called, "the axis in peritrochio;" the pulley; the inclined plane; the wedge; and the screw. Some writers on this subject reduce the six to two, *viz.* the lever, and the inclined plane; the pulley, and wheel and axis being, in their estimation, assemblages of the lever; and the wedge and the screw being modifications of the inclined plane.

When two forces act against each other, by the intervention of a machine, the one is denominated the power, and the other the weight. The weight is the resistance to be overcome, or the effect to be produced. The power is the force, whether animate or inanimate, which is employed to overcome that resistance, or to produce the required effect.

The power and weight are said to balance each other, or to be in equilibrio, when the effort of the one to produce motion in one direction, is equal to the effort of the other to produce it in the opposite direction; or when the weight opposes that degree of resistance which is precisely required to destroy the action of the power. The power of a machine is calculated when it is in a state of equilibrium. Having discovered what quantity of power will be requisite for this purpose, it will then be necessary to add so much more, *viz.* one-fourth, or, perhaps, one-third, to overcome the friction of the machine, and give it motion.

The lever is the simplest of all machines, and is a straight bar of iron, wood, or other material, supported on, and moveable about a prop called the fulcrum. In the lever, there are three circumstances to be principally attended to: 1. The fulcrum, or prop, by which it is supported, or on which it turns as a centre of motion: 2. The power to raise and support the weight: 3. The resistance or weight to be raised or sustained. The points of suspension are those points where the weights really are, or from which they hang freely. The power and the weight are always supposed to act at right angles to the lever, except it be otherwise expressed. The lever is distinguished into three sorts, according to the different situations of the fulcrum, or prop, and the power, with respect to each other. 1. When the prop is placed between the power and the weight, as in steel-yards, scissars, pincers, &c. 2. When the prop is at one end of the lever, the power at the other, and the weight between them, as in cutting knives fastened at, or near the point of the blade; also in oars moving a boat, the water being the fulcrum. 3. When the prop is at one end, the weight at the other, and the power applied between them, as in tongs, sheers, &c.

The lever of the first kind is principally used for loosening large stones; or to raise great weights to small heights, in order to get ropes under them, or other means of raising them to still greater heights: it is the most common species of lever. A B C (Plate I, Mechanics, fig. 1.) is a lever of this kind, in which F is the fulcrum, A the end at which the power is applied, and C the end where the weight acts. To find when an equilibrium will take place between the power and the weight, in this as well as in every other species of lever, we must observe that when the momenta, or quantities of force, in two bodies are equal, they will balance each other. Now, let us consider when this will take place in the lever. Suppose the lever AB, fig. 2, to be turned on its axis, or fulcrum, so as to come into the situation DC; as the end D is farthest from the centre of motion, and as it has moved through the arch AD in the same time as the end B moved through the arch BC, it is evident that the velocity of AB must have been greater than that of B. But the momenta being the products of the quantities of matter multiplied into the velocities, the greater the velocity, the less the quantity of matter to obtain the same product. Therefore, as the velocity of A is the greatest, it will require less matter to produce an equilibrium than B.

Let us now examine how much more weight B will require than A, to balance. As the radii of circles are in proportion to their circumferences, they are also proportionate to similar parts of them; therefore, as the arches, AD, CB, are similar, the radius, or arm, DE, bears the same propor-

tion to E C that the arch A D bears to C B. But the arches A D and C B represent the velocities of the ends of the lever, because they are the spaces which they moved over in the same time; therefore the arms D E and E C may also represent these velocities. Hence, an equilibrium will take place, when the length of the arm A E, multiplied into the power A, shall equal E B, multiplied into the weight B; and consequently, that the shorter E B is, the greater must be the weight B; that is, the power and the weight must be to each other inversely, as their distances from the fulcrum. Thus, suppose A E, the distance of the power from the prop, to be twenty inches, and E B, the distance of the weight from the prop, to be eight inches, also the weight to be raised at B to be five pounds: then the power to be applied at A, must be two pounds; because the distance of the weight from the fulcrum eight, multiplied into the weight five, makes forty; therefore twenty, the distance of the power from the prop, must be multiplied by two, to get an equal product; which will produce an equilibrium.

The second kind of lever, when the weight is between the fulcrum and the power, is represented by fig. 3, in which A is the fulcrum, B the weight, and C the power. The advantage gained by this lever, as in the first, is as great as the distance of the power from the prop exceeds the distance of the weight from it. Thus, if the point *a*, on which the power acts, be seven times as far from A as the point *b*, on which the weight acts, then one pound applied at C will raise seven pounds at B. This lever shews the reason why two men carrying a burden upon a stick between them, bear shares of the burden which are to one another in the inverse proportion of their distances from it.

It is likewise applicable to the case of two horses of unequal strength to be so yoked, as that each horse may draw a part proportionable to his strength; which is done by so dividing the beam they pull, that the point of traction may be as much nearer to the stronger horse than to the weaker, as the strength of the former exceeds that of the latter. To this kind of lever may be reduced rudders of ships, doors turning upon hinges, &c. The hinges being the centre of motion, the hand applied to the lock is the power, while the door is the weight to be moved.

If in this lever we suppose the power and weight to change places, so that the power may be between the weight and the prop, it will become a lever of the third kind; in which, that there may be a balance between the power and the weight, the intensity of the power must exceed the intensity of the weight just as much as the distance of the weight from the prop exceeds the distance of the power. Thus, let E, fig. 4, be the prop of the lever E F, and W, a weight of one pound, placed three times as far from the prop as the power P acts at F, by the cord going over the fixed pulley D: in this case, the power must be equal to three pounds, in order to support the weight of one pound. To this sort of lever are generally referred the bones of a man's arm; for when he lifts a weight by the hand, the muscle that exerts its force to raise that weight, is fixed to the bone about one tenth part as far below the elbow as the hand is. And the elbow being the centre round which the lower part of the arm turns, the muscle must therefore exert a force ten times as great as the weight that is raised. As this kind of lever is a disadvantage to the moving power, it is used as little as possible; but in some cases it cannot be avoided; such as that of a ladder, which being fixed at one end, is by the strength of a man's arms reared against a wall.

What is called the hammer-lever, differs in nothing but its form from a lever of the first kind. Its name is derived from its use, that of drawing a nail out of wood by a hammer. Suppose the shaft of a hammer to be five times as long as the iron part which draws the nail, the lower part resting on the board, as a fulcrum; then, by pulling backwards the end of the shaft, a man will draw a nail with one-fifth part of the power that he must use to pull it out with a pair of pincers; in which case, the nail would move as fast as his hand; but with the hammer, the hand moves five times as much as the nail, by the time that the nail is drawn out. Hence it is evident, that in every species of lever there will be an equilibrium, when the power is to the weight as the distance of the weight from the fulcrum is to the distance of the power from the fulcrum. In experiments with the lever we take care that the parts are perfectly balanced before the weights and powers are applied. The bar, therefore, has the short end so much thicker than the long arm, as will be sufficient to balance it on the prop.

If several levers be combined together in such a manner, as that a weight being appended to the first lever, may be supported by a power applied to the last, as in fig. 5, which consists of three levers of the first kind, and is so contrived, that a power applied at the point L of the lever C, may sustain a weight at the point S of the lever A, the power must here be to the weight, in a ratio, or proportion, compounded of the several ratios, which those powers that can sustain the weight by the help of each lever, when used singly and apart from the rest, have to the weight. For instance, if the power which can sustain the weight W by the help of the lever A, be to the weight as 1 to 5; and if the power which can sustain the same weight, by the lever B alone, be to the weight as 1 to 4; and if the power which could sustain the same weight by the lever C, be to the weight as 1 to 5; then the power which will sustain the weight by help of the three levers joined together, will be to the weight in a proportion consisting of the several proportions multiplied together, of 1 to 5, 1 to 4, and 1 to 5; that is as $1 : 5 \times 4 \times 5$, or of $1 : 100$. For since, in the lever A, a power equal to one-fifth of the weight W pressing down the lever at L, is sufficient to balance the weight, and since it is the same thing whether that power be applied to the lever A at L, or the lever B at S, the point S bearing on the point L, a power equal to one-fifth of the weight P, being applied to the point S of the lever B, will support the weight; but one-fourth of the same power being applied to the point L of the lever B, and pushing the same upward, will as effectually depress the point S of the same lever, as if the whole power were applied at S; consequently a power equal to one-fourth of one-fifth, that is, one-twentieth of the weight P, being applied to the point L of the lever B, and pushing up the same, will support the weight: in like manner, it matters not whether that force be applied to the point L of the lever B, or to the point S of the lever C, since, if S be raised, L, which rests on it, must be raised also; but one-fifth of the power applied at the point L of the lever C, and pressing it downwards, will as effectually raise the point S of the same lever, as if the whole power were applied at S, and pushed up the same; consequently a power equal to one-fifth of one-twentieth, that is, one-hundredth part of the weight P, being applied to the point L of the lever C, will balance the weight at the point S of the lever A. This method of combining levers is frequently used in machines and instruments, and is of great service, either in obtaining a greater power, or in applying it with more convenience.

The balance, an instrument of very extensive use in comparing the weights of bodies, is a lever of the first kind, whose arms are of equal length. The points from which the weights are suspended being equally distant from the centre of motion, will move with equal velocity; consequently if equal weights be applied, their moments will be equal, and the balance will remain in equilibrio. In order to have a balance as perfect as possible, it is necessary to attend to the following circumstances: 1. The arms of the beam ought to be exactly equal, both as to weight and length. 2. The points from which the scales are suspended, should be in a right line, passing through the centre of gravity of the beam; for by this, the weights will act directly against each other, and no part of either will be lost, on account of any oblique direction. 3. If the fulcrum be placed in the centre of gravity of the beam, and if the fulcrum and the points of suspension be in the same right line, the balance will have no tendency to one position more than another, but will rest in any position it may be placed in, whether the scales be on or off, empty or loaded. If the centre of gravity of the beam, when level, be immediately above the fulcrum, it will overset by the smallest action; that is, the end which is lowest will descend; and it will do this with more swiftness, the higher the centre of gravity be, and the less the points of suspension be loaded. But if the centre of gravity of the beam be immediately below the fulcrum, the beam will not rest in any position but when level; and if disturbed from that position, and then left at liberty, it will vibrate, and at last come to rest on the level. In a balance, therefore, the fulcrum ought always to be placed a little above the centre of gravity. Its vibrations will be quicker, and its horizontal tendency stronger, the lower the centre of gravity, and the less the weight upon the points of suspension. 4. The friction of the beam upon the axis ought to be as little as possible; because, should the friction be great, it will require a considerable force to overcome it; upon which account, though one weight should a little exceed the other, it will not prepon-

derate, the excess not being sufficient to overcome the friction, and bear down the beam. 5. The pivots, which form the axis or fulcrum, should be in a straight line, and at right angles to the beam. 6. The arms should be as long as possible, relatively to their thickness, and the purposes for which they are intended, as the longer they are the more sensible is the balance. They should also be made as stiff and inflexible as possible; for if the beam be too weak, it will bend, and become untrue. 7. The rings, or the piece on which the axis bears, should be hard and well polished, parallel to each other, and of an oval form, that the axis may always keep its proper bearing, or remain always at the lowest point. 8. If the arms of a balance be unequal, the weights in equipoise will be unequal in the same proportion. The equality of the arms is of use, in scientific pursuits, chiefly in the making of weights by bisection. A balance with unequal arms will weigh as accurately as another of the same workmanship with equal arms, provided the standard weight itself be first counterpoised, then taken out of the scale, and the thing to be weighed be put into the scale, and adjusted against the counterpoise. Or, when proportional quantities only are considered, the bodies under examination may be weighed against the weights, taking care always to put the weights in the same scale; for then, though the bodies may not be really equal to the weights, yet their proportions amongst each other will be the same as if they had been accurately so. 9. Very delicate balances are not only useful in nice experiments, but are likewise much more expeditious than others in common weighing. If a pair of scales, with a certain load, be barely sensible to one-tenth of a grain, it will require a considerable time to ascertain the weight to that degree of accuracy, because the turn must be observed several times over, and is very small. But if no greater accuracy were required, and scales were used, which would turn with one-hundredth of a grain, a tenth of a grain more or less would make so great a difference in the turn, that it would be seen immediately.

The statera, or Roman steel-yard, is a lever of the first kind, and is used for finding the weights of different bodies, by one single weight placed at different distances from the prop or centre of motion D, fig. 6. For, the shorter arm D G is of such a weight as exactly to counterpoise the longer arm D X. If this arm be divided into as many equal parts as it will contain, each equal to G D, the single weight P (which we may suppose to be one pound) will serve for weighing any thing as heavy as itself, or as many times heavier as there are divisions in the arm D X, or any quantity between its own weight and that quantity. As for example, if P be one pound, and placed at the first division 1 in the arm D X, it will balance one pound in the scale at W; if it be removed to the second division at 2, it will balance two pounds in the scale; if to the third, three pounds; and so on to the end of the arm D X. If any of these integral divisions be subdivided into as many equal parts as a pound contains ounces, and the weight P be placed at any of these subdivisions, so as to counterpoise what is in the scale, the pounds and odd ounces therein will by that means be ascertained. In the Danish and Swedish steel-yard, the body to be weighed, and the constant weight, are fixed at the extremities of the steel-yard, but the point of suspension or centre of motion moves along the lever till the equilibrium takes place. The centre of motion therefore shews the weight of the body.

The wheel and axle, or axis in peritrochio, is a machine much used, and is made in a variety of forms. It consists of a wheel with an axle fixed to it, so as to turn round with it; the power being applied at the circumference of the wheel, the weight to be raised is fastened to a rope which coils round the axle.

A B (fig. 7.) is a wheel, and C D an axle fixed to it, and which moves round with it. If the rope which goes round the wheel be pulled, and the wheel turned once round, it is evident that as much rope will be drawn off as the circumference of the wheel; but while the wheel turns once round, the axle turns once round; and consequently the rope by which the weight is suspended will wind once round the axis, and the weight will be raised through a space equal to the circumference of the axis. The velocity of the power, therefore, will be to that of the weight, as the circumference of the wheel to that of the axis. In order, therefore, that the power and the weight may be in equilibrio, the power must be to the weight as the circumference of the wheel to that of the axis. Circles being to each other as their respective diameters, the power is to the weight, as the diameter also of the axis to that of the wheel. Thus, suppose the

diameter of the wheel to be eight inches, and the diameter of the axis to be one inch; then one ounce acting as the power P, will balance eight ounces as a weight W; and a small additional force will cause the wheel to turn with its axis, and raise the weight; and for every inch which the weight rises, the power will fall eight inches.

The wheel and axis may be considered as a kind of perpetual lever, (fig. 8.) of which the fulcrum is the centre of the axis, and the long and short arms the diameter of the wheel and the diameter of the axis. From this it is evident, that the longer the wheel, and the smaller the axis, the stronger is the power of this machine; but then the weight must rise slower in proportion. A capstan is a cylinder of wood, with holes in it, into which are put bars, or levers, to turn it round; these are like the spokes of a wheel without the rim. Sometimes the axis is turned by a winch fastened to it, which, in this respect, serves for a wheel, and is more powerful, in proportion to the largeness of the circle it describes, compared with the diameter of the axle. When the parts of the axis differ in thickness, and weights are suspended at the different parts, they may be sustained by one and the same power applied to the circumference of the wheel, provided the product arising from the multiplication of the power into the diameter of the wheel, be equal to the sum of the products arising from the multiplication of the several weights into the diameters of those parts of the axis from which they are suspended. In considering the theory of the wheel and axle, we have supposed the rope that goes round the axle to have no sensible thickness; but as in practice this cannot be the case, if it is a thick rope, or if there be several folds of it round the axis, you must measure to the middle of the outside rope to obtain the diameter of the axis, for the distance of the weight from the centre is increased by the coiling up of the rope.

If teeth are cut in the circumference of a wheel, and if they work in the teeth of another wheel of the same size as fig. 9. it is evident that both the wheels will revolve in the same time; and the weight appended to the axle of the wheel B, will be raised in the same time as if the axle had been fixed to the wheel A. But if the teeth of the second wheel be made to work in teeth made in the axle of the first, as at fig. 10. as every part of the circumference of the second wheel is applied successively to the circumference of the axle of the first, and as the former is much greater than the latter, it is evident that the first wheel must go round as many times more than the second, as the circumference of the second wheel exceeds that of the first axle. In order to a balance here, the power must be to the weight, as the product of the circumferences, or diameters of the two axles multiplied together, is to the circumferences or diameters of the two wheels. This will become sufficiently clear, if it be considered as a compound lever, which was explained above. Instead of a combination of two wheels, three or four wheels may work in each other, or any number; and by thus increasing the number of wheels, or by proportioning the wheels to the axis, any degree of power may be acquired. To this sort of engine belong all cranes for raising great weights; and in this case the wheel may have cogs all round it, instead of handles; and a small lanthorn, or trundle, may be made to work in the cogs, and be turned by a winch; which will make the power of the engine to exceed the power of the man who works it, as much as the number of revolutions of the winch exceeds those of the axle, when multiplied by the excess of the length of the winch above the length of the semi-diameter of the axle, added to the semi-diameter or half thickness of the rope, by which the weight is drawn up. See CRANE.

The construction of the main-spring-box of the fusee of a watch round which the chain is coiled will illustrate the principle of the wheel and axis. The box may be considered as the wheel, and the fusee the axle or pinion to which the chain communicates the motion of the box. The power resides in the spring wound round an axis in the centre of the box, and the weight is applied to the lower circumference of the fusee. As the force of the spring is greatest when newly wound up, and gradually decreases as it unwinds itself, it is necessary that the fusee should have different radii, so that the chain may act upon the smallest part of the fusee when its force is greatest, and upon the largest part of the fusee when the force is least, for the equable motion of the watch requires that the inequality in the action of the spring should be counteracted so as to produce an uniform effect.

The pulley is a small wheel turning on an axis, with a drawing rope passing over it; the small wheel is usually called a sheeve, and is so fixed in a box, or block, as to be

moveable round a pin passing through its centre. Pullies are of two kinds; fixed, which do not move out of their places; and moveable, which rise and fall with the weight.

When a pulley is fixed, as Plate II. Mechanics, fig. 11. two equal weights suspended to the ends of a rope passing over it will balance each other, for they stretch the rope equally, and if either of them be pulled down through any given space, the other will rise through an equal space in the same time; and consequently, as the velocities of both are equal, they must balance each other. This kind of pulley, therefore, gives no mechanical advantage; but its use consists in changing the direction of the power, and sometimes enabling it to be applied with more convenience. By it, a man may raise a weight to any point, as the top of a building, without moving from the place he is in; whereas, otherwise, he would have been obliged to ascend with the weight; it also enables several men together to apply their strength to the weight by means of the rope. The moveable pulley represented at A (fig. 12.) is fixed to the weight W, and rises and falls with it. In comparing this to a lever, the fulcrum must be considered as at A, the weight acts upon the centre c, and the power is applied at the extremity of the lever D. The power, therefore, being twice as far from the fulcrum as the weight is, the proportion between the power and weight, in order to balance each other, must be as 1 to 2. Whence it appears, that the use of this pulley doubles the power, and that a man may raise twice as much by it as by his strength alone. Again, every moveable pulley hangs by two ropes equally stretched, and which must, consequently, bear equal parts of the weight; but the rope A B being made fast at B, half the weight is sustained by it, and the other part of the rope, to which the power is applied, has but half the weight to support; consequently the advantage gained by this pulley is as 2 to 1. When the upper and fixed block contains two pullies, which only turn upon their axis, and the lower moveable block contains also two, which not only turn on their axis, but rise with the weight F (fig. 13.) the advantage gained is as 4 to 1. For each lower pulley will be acted upon by an equal part of the weight; and because in each pulley that moves with the weight a double increase of power is gained, the force by which F may be sustained will be equal to half the weight divided by the number of lower pullies; that is, as twice the number of lower pullies is to 1, so is the weight suspended to the power. But if the extremity C (fig. 14.) be fixed to the lower block, it will sustain half as much as a pulley; consequently here the rule will be, as twice the number of pullies adding unity is to 1, so is the weight to the power. These rules hold good, whatever may be the number of pullies in the blocks. If, instead of one rope going round all the pullies, the rope belonging to each pulley be made fast at top, as in fig. 15, a different proportion between the power and the weight will take place. Here it is evident, that each pulley doubles the power; thus, if there are two pullies, the power will sustain four times the weight; if three pullies, eight times the weight; if four pullies, sixteen times; and so on: that is, the power P of 1*lb.* will sustain a weight W of 16*lb.*

When pullies in blocks are placed perpendicularly under each other, on separate pins, they occupy considerable space, and would not in general answer; it is, therefore, common to place all the pullies in each block on the same pin, by the side of each other, as in fig. 16. but the advantage and rule for the power, are the same here as in fig. 13 and 14. A pair of blocks with the rope fastened round it, is commonly called a tackle.

To avoid, in a great measure, the friction of several pullies running on different pivots, Mr. James White, a very able mechanic, invented the concentric pulley, (fig. 17.) for which he obtained a patent. O and R are two brass pullies in which grooves are cut; round these a cord is passed, by which means the two answer the same purpose of so many distinct pullies as there are grooves; and the advantage gained is found by doubling the number of grooves in the lower block. In this case the advantage gained is 12, that is, a power of 12*lb.* will balance a weight of 144. The concentric pulley removes very considerably the shaking motion of the common pulley as well as the friction.

The inclined plane is of very great use in rolling up heavy bodies, such as casks, wheel-barrows, &c. It is formed by placing boards, or earth, in a sloping direction. The force with which a body descends upon an inclined plane, is to the force of its absolute gravity, by which it would descend perpendicularly in free space, as the height of the plane is to its length. For suppose the

plane A B (fig. 18,) to be parallel to the horizon, the cylinder C will keep at rest on any part of the plane where it is laid. If the plane be placed perpendicularly, as A B, (fig. 19,) the cylinder C will descend with its whole force of gravity, because the plane contributes nothing to its support or hindrance; and therefore it would require a power equal to its whole weight to keep it from descending. Let A B (fig. 10.) be a plane parallel to the horizon, and A D a plane inclined to it; and suppose the whole length A D to be four times as great as the perpendicular D B. In this case, the cylinder E will be supported upon the plane D A, and kept from rolling, by a power equal to a fourth part of the weight of the cylinder; therefore a weight may be rolled up this inclined plane, by a third part of the power which would be sufficient to draw it up by the side of an upright wall. It must also be evident, that the less the angle of elevation, or the gentler the ascent is, the greater will be the weight which a given power can draw up; for the steeper the inclined plane is, the less does it support of the weight; and the greater the tendency which the weight has to roll, consequently the more difficult for the power to support it: the advantage gained by this mechanical power, therefore, is as great as its length exceeds its perpendicular height. To the inclined plane may be reduced all hatchets, chisels, and other edge-tools.

The inclined plane, when combined with other machinery, is often of great use in the elevation of weights: it has been likewise made use of in the late Duke of Bridgewater's canal. After this canal has extended about 40 miles on the same level, it is joined to a subterraneous navigation about 12 miles long, by means of an inclined plane, and this subterraneous portion is again connected by an inclined plane with another portion 100 feet above it. This plane is a stratum of stone which slopes one foot in four, and is about 450 feet long. The boats are conveyed from one level to another by means of a windlass, so that a loaded boat descending along the plane turns the axis of the windlass, and raises an empty boat.

The fifth mechanical power or machine is the wedge; which may be considered as two equally inclined planes, joined together at their bases; then D G (fig. 21.) is the whole thickness of the wedge at its back A B G D, where the power is applied; E F is the depth or height of the wedge; B F the length of one of its sides; and O F is its sharp edge, which is entered into the wood intended to be split, by the force of a hammer or mallet striking perpendicularly on its back. Thus, A B (fig. 22.) is a wedge driven into the cleft C E D of the wood F G. When the wood does not cleave at any distance before the wedge, there will be an equilibrium between the power impelling the wedge downward and the resistance of the wood acting against the two sides of the wedge, when the power is to the resistance as half the thickness of the wedge at its back is to the length of either of its sides; because the resistance then acts perpendicularly to the sides of the wedge. But when the resistance on each side acts parallel to the back, the power that balances the resistances on both sides will be, as the length of the whole back of the wedge is to double its perpendicular height.

When the wood cleaves at any distance before the wedge (as it generally does) the power impelling the wedge will not be to the resistance of the wood as the length on the back of the wedge is to the length of both its sides, but as half the length of the back is to the length of either side of the cleft, estimated from the top or acting part of the wedge. For, if we suppose the wedge to be lengthened down from the top C E, to the bottom of the cleft at D, the same proportion will hold; namely, that the power will be to the resistance as half the length of the back of the wedge is to the length of either of its sides: or, which amounts to the same thing, as the whole length of the back is to the length of both the sides. The wedge is a very great mechanical power, since not only wood, but even rocks, can be split by it; which it would be impossible to effect by the lever, wheel, and axle, or pulley; for the force of the blow, or stroke, shakes the cohering parts, and thereby makes them separate more easily.

The sixth and last mechanical power is the screw; which cannot properly be called a simple machine, because it is never used without the application of a lever or winch to assist in turning it; and then it becomes a compound engine of a very great force, either in pressing the parts of bodies closer together, or in raising great weights. It may be conceived to be made by cutting a piece of paper, A B C (fig. 23.) into the form of an inclined plane, or half wedge; and then wrapping it round a cylinder (fig.

24.) the edge of the paper A C will form a spiral line round the cylinder, which will give the thread of the screw. It being evident that the winch must turn the cylinder once round, before the weight of resistance can be moved from one spiral winding to another, as from *d* to *c*; therefore, as much as the circumference of a circle described by the handle of the winch is greater than the interval or distance between the spirals, so much is the force of the screw. Thus, supposing the distance of the spirals to be half an inch, and the length of the winch twelve inches, the circle described by the handle of the winch where the power acts, will be 76 inches nearly, or about 152 half inches; and consequently 152 times as great as the distance between the spirals; and therefore a power at the handle, whose intensity is equal to no more than a single pound, will balance 152 pounds acting against the screw; and as much additional force as is sufficient to overcome the friction, will raise the 152 pounds; and the velocity of the power will be to the velocity of the weight, as 152 to 1. Hence it appears, that the longer the winch is, and the nearer the spirals are to one another, so much the greater is the force of the screw.

A machine for shewing the force or power of the screw may be contrived in the following manner: let the wheel C have a screw, (fig. 25.) on its axis, working in the teeth of the wheel D, which suppose to be 48 in number. It is plain, that for every time the wheel C and screw are turned round by the winch A, the wheel D will be moved one tooth by the screw; and therefore, in 48 revolutions of the winch, the wheel D will be turned once round. Then, if the circumference of a circle, described by the handle of the winch A, be equal to the circumference of a groove round the wheel D, the velocity of the handle will be 48 times as great as the velocity of any given point in the groove. Consequently, if a line G goes round the groove, and has a weight of 48 pounds hung to it, a power equal to 1 pound at the handle will balance and support the weight. To prove this by experiment, let the circumferences of the grooves of the wheels C and D be equal to one another, and then if a weight H, of one pound, be suspended by a line going round the groove of the wheel C, it will balance a weight of 48 pounds hanging by the line G; and a small addition to the weight H will cause it to descend, and so raise up the other weight.

If a line G, instead of going round the groove of the wheel D, goes round its axle I, the power of the machine will be as much increased as the circumference of the groove exceeds the circumference of the axle: which supposing it to be six times, then one pound at H will balance six times 48, or 288 pounds, hung to the line on the axle: and hence the power or advantage of this machine will be as 288 to 1. That is to say, a man, who by his natural strength could lift an hundred weight, will be able to raise 288cwts. by this engine. If a system of pullies were applied to the cord H, the power would be increased to an amazing degree. When a screw acts in a wheel in this manner, it is called an endless screw. When it is not employed in turning a wheel, it consists of two parts: the first is called the male, or outside screw, being cut in such a manner as to have a prominent part going round the cylinder in a spiral manner; which prominent part is called the thread of the screw; the other part, which is called the female, or inside screw, is a solid body, containing a hollow cylinder, whose concave surface is cut in the same manner as the convex surface of the male screw, so that the prominent parts of the one may fit the concave parts of the other. A very considerable degree of friction always acts against the power in a screw; but this is fully compensated by other advantages; for on this account the screw continues to sustain a weight, even after the power is removed, or ceases to act, and presses upon the body against which it is driven. Hence the screw will sustain very great weights, insomuch, that several screws, properly applied, would support a large building, whilst the foundation was mending, or renewed.

The screw is of extensive use in the printing-press, and in the press for coining money, and in a great variety of other purposes. It has lately been employed in the flour mills in America, for pushing the flour which comes from the mill stones to the end of a long trough, from which it is conveyed to other parts of the machinery, in order to undergo the remaining processes. In this case, the spiral threads are very large in proportion to the cylinder on which they are fixed. As the lever used with the screw moves through a large space when compared with the velocity of its other extremity, or of any body which it puts in motion; the screw is of very great use in subdividing any space into a great number

of minute parts. Hence it is employed in the engines for dividing mathematical instruments, &c. See OSCILLATION, PENDULUM, SUSPENSION, &c.

MEDAL. This word has generally been supposed to be derived from Metallum, from which we have the English term metal; but it may admit of some doubt whether the derivation is correct, as the word appears to have too comprehensive a sense to particularize a piece of gold, silver, brass, or copper, impressed with figures to convey to posterity some great historical occurrence, or to perpetuate the memory of a person who had rendered the state in which he lived an essential service.

We are indebted to the very ancient inhabitants of the world for this method of immortalizing their most important acts and most exalted characters, a method, the discovery or invention of which, would do honour to an age enlightened by arts and literature, then unknown. Had the same inclination to preserve those indelible mementos prevailed throughout the countries which prompted the making of them, we should have possessed a series of valuable information now for ever interrupted, to the constant regret of the historian, who is compelled to wander in a maze of conjecture, caused by allusions in the works of ancient writers, that were well known to the public at the time when they were made, but all clue to which is entirely lost. The satisfaction demonstrated by the learned of every nation on the accidental discovery of an unknown medal, sufficiently evinces their importance; if the relief is tolerably perfect, or the inscription nearly or quite legible, every individual becomes an enthusiast in research, and it has frequently happened that an important blank in chronology, history, or geography, has been unexpectedly and satisfactorily filled by this means. One very material circumstance contributes to render ancient medals valuable, which is their undoubted authenticity; in short, they are the historical acts of kings and states, the durable gazettes of antiquity; they inform the world that at such a period a monarch ascended a throne, a victory was achieved, the foundations of a city were laid, or a temple erected, and they sometimes introduce to our notice persons, towns, and buildings, which have not been mentioned by any of the ancient writers extant.

Viewing medals in this light, it is a matter of some surprise that collections have not been formed in every age and country, that they have not may be inferred from the extreme rarity of some particular descriptions; had collections been universal, surely a much greater number of medals must have reached us, making due allowance for decay, violence, melting, and losses during foreign and civil wars. Mr. Pinkerton inclines to think the world entertained but little regard for the medals made by the numerous small states using the Greek characters and language, supposing that their numbers rendered them of little value; this idea is extremely probable if extended to the mass of mankind; but as there ever has been individuals of superior taste and acquirements scattered in every soil, we might have imagined the aggregate of those persons sufficiently great to preserve a larger number than is now to be found.

Many ingenious speculations might be formed as to the origin of medals; it is not, however, safe or pleasant to wander in the shades of antiquity without guides, or a ray of light, we must therefore be contented with the few facts which have been gleaned by writers on this subject. From those it appears, that we are principally indebted to the Romans for the preservation of the most valuable Greek medals; indeed, that ambitious people did themselves more honour by their successful study of the arts of Greece, than by the conquests they achieved in every part of the globe then known; with minds elevated beyond the paltry consideration of envy, they not only collected the medals of that country, but directed their artists to imitate the beauty of their reliefs, and the gracefulness of their outlines. The encouragement thus afforded by the various governments of Rome, created a spirit of emulation amongst the higher orders of the public, and collections were formed, to which every subsequent cabinet has been more or less indebted. Whether the medals possessed by the curious at that period were methodically arranged, so as to preserve the chronology of facts, cannot now be ascertained; but we are very certain that numbers of great value and importance must have been irrecoverably lost since the time alluded to, and that the series, in many cases, has been interrupted by the havock committed at each conquest of the mistress of the world. The philosopher and the historian will ever dwell with regret on that long mental night which enveloped those happy regions

where science and the arts had flourished, and whence their influence had diverged to surrounding nations; but they must exult in the recollection of the gradual return of day, which at length reached its meridian, and exhibited a grand picture of learning and the liberal arts. Upon their revival the study of medals became an object of primary importance, and Petrarch appears at the head of those who justly appreciated their value; sensible of the spirit of emulation they were calculated to inspire, he sent the Emperor, Charles IV., several made in honour of great and good men, with an invitation to imitate their conduct.

Alphonso, King of Arragon, acted upon the principle recommended by Petrarch, and carried a collection he had ordered to be made, constantly with him, in order that he might remember the qualities which caused their being struck. Examples like those were not without imitation in succeeding periods, but the most noble and magnificent consequence was the Cabinet of Cosmo de Medici, which was for a long time the admiration of Europe. Keysler, who saw this collection in 1730, asserts, that "with regard to the number of old coins, they reckon at present three hundred and twelve medallions, among which are forty-five of silver. The largest copper medallion is a Julia, the consort of Septimus Severus. The copper coins of the smaller size amount to about eight hundred, and those of the larger size to one thousand eight hundred. The middle sort, by the French called *Moyen Bronze*, are two thousand two hundred, and this collection is the most valuable and curious, containing a great number of Greek coins. Among the silver pieces are eight hundred consular ones, and upwards of two thousand others. Here are six hundred pieces of gold, and sixteen medallions of the same metal. I was assured by Bianchi, that the largest gold medal weighs one hundred and sixteen Louis d'ors, and represents the Emperor John Palæologus VI., who assisted at the Council of Florence.

The number of medals in gold, silver, and copper, struck in honour of cities and countries, amounts to fifteen hundred. The gold and copper ones of this assortment are the most curious. The whole collection consists of fourteen thousand ancient, and eight thousand modern medals. Of the latter there are nine hundred of gold, and two thousand of silver, amongst which the largest is that of Cosmo III., and upwards of three thousand in copper.

This collection eclipsed every other, though there were many of very great extent in different parts of the continent; nor have the learned of England been deficient in their exertions to procure those useful evidences of past transactions. Camden, who first engraved medals for his valuable works, is supposed to have been one of the first collectors; to whom may be added, Sir Robert Cotton. Henry, Prince of Wales, son of James I., possessed thirty thousand coins and medals. Archbishop Laud gave five thousand five hundred coins to the Bodleian library. The Earl of Arundel, celebrated for his taste in selecting specimens of antiquity, had an excellent collection of medals; and Evelyn enumerates the Dukes of Hamilton and Buckingham, Sir Thomas Fanshaw, Sir William Paston, Sir Thomas Hanmer, Messrs. Sheldon, Selden, and many others, as having in their possession cabinets of medals. Charles I., a monarch who would have done more to improve the state of the arts in England than all his predecessors, had his reign been happy, collected a vast number, which were lost after his dethronement; and his historian, Lord Clarendon, endeavoured to rival his royal master in this interesting pursuit, which appears to have been in some degree a favourite one with Oliver Cromwell.

Charles II. entertained a similar partiality for medals, but his successors have entirely neglected them, and suffered their subjects to set them an example which it is much to be wished they had followed. Amongst those were Sir Hans Sloane, the Earls of Pembroke and Winchelsea, and several others, mentioned by Haym, who wrote about 1720. Since the above period our general knowledge of medals has been considerably increased, and the skill with which the most recent collections were made, does infinite honour to the penetration and acumen of our medallists, who are frequently enabled to detect fictitious pieces, which have been made with sufficient art to impose upon foreigners. Several noblemen and gentlemen now possess rich cabinets, and the British Museum contains a superb collection derived from numerous sources.

Medals have from necessity been uniformly struck on copper, variously mixed with other substances, silver, and gold, the most ancient of the latter metal are evidently in its native state, neither purified

or combined with copper, though there are some which are supposed to be of gold and silver. Philip of Macedon caused the gold used for coining in his dominions to be made of the utmost purity, and in this particular he was imitated by Alexander the Great, and others nearly his contemporaries. The Romans profiting by the experience of ages, and perceiving that the purity of the metal improved the beauty of the impression, determined to use it in as perfect a state as possible; the silver coins of that people were less pure, and became at length greatly debased.

The pure brass medals, and the red, or copper, called by the ancients Cyprian brass, were generally covered by platina. The best mixture was electrum, composed of one fifth of silver, and the remainder of gold: in some instances this was a natural combination, in others artificial. Pinkerton says, the earliest Lydian coins, and those of particular states of Asia Minor, are of this description, as are those of the Kings of the Bosphorus Cimmerius, during the imperial ages of Rome. The Egyptian coins, made when that country was under the dominion of Rome, were at first of good silver, but degenerated afterwards; indeed lead, and even tin, have been used for the purposes of money.

The shapeless coins of very great antiquity were mere fragments of metal, the value of which was regulated entirely by weight, and this method extended to the comparatively worthless substance, brass. The silver coins of Greece, first known as bearing marks, are those with a tortoise on one side, and indented on the other; it is extremely doubtful when these coins were made, but they are supposed to have been from the celebrated mint of Ægina, where, according to some writers, the first coinage of money took place by command of Phidon, King of the Argives. Herodotus asserts, that the Lydians invented the art of impressing figures on their coins, whether correctly or not, cannot now be decided. Phidon is said to have lived about eight hundred and fifty years before the Christian æra, and the tortoise is known to be the badge of the Peloponnesus.

The drachma, or eighth part of an ounce, was the leading denomination of the Grecian money, and their coins were generally named from their weights, though sometimes the case was reversed; the silver drachma was equivalent on a medium to nine-pence sterling, and the Romans considered their denarius as of the same value with the drachma. The didrachm of silver was double the amount of the drachma; the tridrachm was three drachmas, and the tetradrachm, the largest of Greek silver coins, except the tetradrachm of the Eginean standard, is equivalent to five shillings of our money.

The silver drachma was divided into several denominations, as the tetrobolion worth a modern sixpence; the hemidrachm, or triobolion, the diobolion, the obulus, the hemiobolion, the tetartobolion, and the dichalcos; the latter was worth about a farthing and a half. Very few of those minute silver coins have reached us, and others are mentioned by Greek writers, which were still less, and are consequently entirely decayed, or have been overlooked or neglected for the larger species.

It may be proper in noticing these coins, to mention the figures impressed on some of them, for instance, Pallas and Proserpine on the tetradrachm, and the troizene; the cistophori had the mystic chest of Bacchus, with a serpent rising out of it; but the Athenian coins were the most numerous, though the execution of them was indifferent. The first copper coins extant are Syracusan; those of Greece are the chalcos, originally of very inconsiderable value. It does not appear that gold was used for this purpose in Greece before the reign of Philip of Macedon, and Athens was destitute of this description of money at the commencement of the Peloponnesian war; Sicily had set the example in this respect, the government of which island had issued gold coins four hundred and ninety-one years before Christ. The Χρυσος, or Philippus was a didrachm, the common form of gold coins of very remote times, and was equal in value to one pound sterling. The Philippus was divided into four parts, and there were still smaller coins of this precious metal. The Διχρυσος of Alexander and Lysimachus was of greater value than the Philippus, and is said to have been worth forty shillings of our money. Some of the Egyptian monarchs quadrupled the Χρυσος, consequently their coins equalled four pounds.

The Romans estimated their money by weight, as the Greeks had done before, but they differed from that people in adopting silver for their coins, as they used copper, not in preference, but from necessity. The Roman pound was twelve ounces, consisting of four hundred and fifty-eight

grains, though the money-ounce appears to have been four hundred and twenty troy grains, or five thousand and forty to the pound; this was the standard of copper. After silver was introduced, the ounce consisted of seven denarii, and gold was estimated by the scruple, the third part of a denarius, and the preceding weights. The sestertius, or half the third, a division of the number ten equally improper, and subsequently unusual, was chosen by the Romans as the principle estimate of their money. Servius Tullus introduced the practice of impressing figures on their copper or aes, which were those of pecus, or small cattle, from which circumstance the word pecunia was derived. This manner of distinguishing the coin was afterwards changed, and Janus on one side, and the prow of a galley on the other, became the marks of the aes; this, with the triens, the quadrans, and sextans, impressed with the form of a vessel, were for a very long period the only medium; but five years before the first Punic war, circumstances had enabled the Romans to use silver, which they coined into denarii, bearing the head of the genius of Rome, with a helmet on one side, and on the other chariots drawn by two or four horses. The coin called victoriati received the figures of Victory and of Rome; and the sestertii generally had the protectress of the city, with Castor and Pollux.

The Emperors usually ordered their own busts to be placed on their coins, except Augustus, who had Capricorn. Sixty-two years elapsed between the introduction of silver and that of gold, which occurred in the consulship of M. Livius Salinator. The as, derived from æs, brass, originally consisted of one pound weight, but the difficulties experienced during the first Punic war, compelled the public to reduce the value of the as, and to convert one into six ases. The success of Hannibal in the second contest, under the above term, produced still greater distress in the state, and another reduction in their value took place, when the as became but one ounce in weight; this was again reduced, by a law of Papyrius, to half an ounce, in which state it afterwards remained. The as, supposed by Kennet to be equal in value to a farthing and a half sterling, was the tenth part of the denarius, and the semi-æs, or semissis, was the half; the triens, as the word implies, was the third part of the as, and the quadrens the fourth, which was sometimes called triuncis and teruncius, as it weighed three ounces previous to the diminution of its value. The sextans, or sixth part, were not sufficiently numerous, and other divisions were made to answer the public convenience, such as the uncia, or twelfth part of the pound, the semi-uncia, and the sextula, or sixth part of an ounce; besides these there was the decussus, valued at ten ases, or one denarius; the vicessus, the value of two denarii; and the centussis was the largest coin of this metal, which was worth ten denarii, or one hundred ases, and may be said to be equivalent to six shillings and three-pence sterling.

The ancient denarius seems to have derived its name from the fact of its containing denos-æris or ases, or ten ases, though the weight varied; during the time of the Commonwealth it was the seventh part of an ounce. In that of Claudius the weight was precisely an attic-drachm; the former equalled eight-pence of our money, and the latter seven-pence, without entering into fractions in either case. Bigatus and quadrigatus were terms applied to the denarius, alluding to the bigæ or chariot with two horses impressed upon it, and the quadrigæ or chariot with four horses. Clodius introduced the victoriatus mentioned before, which was equal in value to the half of a denarius; it also bore the name of quinarius, from its containing the value of five ases. The celebrated sestertius, so called from sesquitertius, as consisting of two ases and a half, was half the victoriatus, and a fourth part of the denarius; exclusive of the above name it was frequently called nummus and sestertius nummus, the value of which, in modern money, was extremely small, being little more than one penny. The obulus, or the sixth part of the denarius, was nearly of the same amount. The libella, the tenth of the denarius, equalled the as, or the supposed pound of copper or brass. The semi-libella explains itself, and the teruncius, or fortieth part of the denarius, was worth three ounces of the metal just mentioned.

The most remarkable Roman coins of gold were the aurei denarii, which were thus termed probably from their resemblance in size, or the simularity of the figures they bore on their surfaces to the denarii. Those coined under the Commonwealth weighed two silver denarii, and were worth seventeen shillings, one penny, and something more than a farthing sterling; the aureus, made after the change in

the government, weighed two drachms, and was equal to no more than fifteen shillings of our money: during the time of the five first Cæsars they continued didrachmi; but the avarice of succeeding emperors induced them to reduce their weight considerably, which was restored by Domitian and Aurelian. It was under Philip that aurei of several sizes first appeared, those bear the bust of the genius of Rome on one side, and different objects on their reverses; the inelegance of the workmanship induces a supposition that they were made far from the seat of the arts. Mr. Pinkerton is inclined to think, the only alteration made in the Roman money by Aurelian was confined to the gold. At the commencement of the coinage of gold, the aureus was divided into the semissis of sixty sestertii; the tremissis, or third, of forty; another division of thirty; and a sixth or scrupulum of twenty; all of which were discontinued except the semissis or half of the aureus.

There is no part of the study of medals and coins more interesting than that of the class bearing portraits or busts of eminent persons; of those, the Macedonian are the first so distinguished; and it has been usual to begin the series with Alexander I., who reigned 500 years before the Christian era, or 2,308 years past; as his coin is the most ancient yet discovered. Next to the monarchs of Macedon, follow the kings and queens of Sicily, Caria, Cyprus, Heraclia and Pontus; to which succeed the kings of Egypt, Syria, the Cimmerian Bosporus, Thrace, Bythinia, Parthia, Armenia, Damascus, Cappadocia, Paphlagonia, Pergamus, Galatia, Cilicia, Sparta, Pæonia, Epirus, Illyricum, Gaul, and the Alps, including a period of nearly 330 years, or from the time of Alexander the Great to the birth of Christ. According to Pinkerton, "the last series of ancient kings goes down to the fourth century, and includes some of Thrace, the Bosporus, and Parthia; those of Commagene, Edossa, or Osrhsene, Mauritania, and Judæa." The above are the series of portraits of kings impressed on medals which have Greek characters; many are extant of eminent men, on coins of Greek origin.

The series of Roman emperors is complete, from Julius to the destruction of Rome by the Goths; after the latter period the execution of the heads became very barbarous. The Greek coins, bearing their kings, generally exhibit them with diadems, and no other ornament; and they invariably present the profile; those of Grecian cities of high antiquity, and Roman consular coins, on the contrary, have specimens of full faces; and there are instances of others, on which several busts have been introduced, particularly a beautiful gold one of Ptolemy Philadelphus, who introduced the heads of himself and Arsinoe on one side, and those of Ptolemy I. and Berenice, his parents, on the other. Two or more heads have been impressed, in some cases grouped and looking the same way, and in others they are placed face to face; the reverses on those having nothing remarkable to distinguish them; but the most rare and valuable coins contain three heads.

The vitta, or diadem, which resembles a modern riband tied round the head by a graceful knot, with the extremities floating in the air, is the distinctive emblem of a prince throughout the Greek medals; and it was imitated by some of the Roman magistrates; but the popular prejudice was so great against this badge of supreme authority, that their emperors thought proper to wear the radiated crown full 200 years before they ventured to resume it. "In the family of Constantine," says Pinkerton, "the diadem becomes common, though not with the ancient simplicity; being ornamented on either edge with a row of pearls and various other decorations." The crown, composed of branches of laurel, was an emblem of conquest when first adopted, as was the radiated crown a mark of deification originally; but each were afterwards assumed on their medals by ambitious and presumptuous emperors; in those of the lower empire, a hand is shewn holding the laurel above the head, which disposition of it was considered a mark of piety.

The rostral crown, made of gold, and resembling the prows of gallies connected, was exhibited by Agrippa on his coins, who also appears in the mural, assigned to those that distinguished themselves in first scaling the walls of a besieged city; the crown of oak branches, considered as a civic one, was adjudged to him who saved the life or lives of citizens; this frequently appeared on reverses, and particularly on the coins of Galba. Grecian princes adopted the crown of laurel, and added it to the diadem; and the kings of Parthia wore drapery folded round the head, and over their hair curled in several ranges. The kings of Armenia had the tiara, the ancient eastern badge of imperial power; and Juba,

the father, is shown in a conic cap set with pearls.

The vanity of the successors of Alexander the Great was conspicuous in each of their emblems, which induced them to take the lion's skin of Hercules; the horn, as a badge of their power, or probably as an intimation that they were the successors of the pretended son of Jupiter Ammon; and the wing, as a symbol of the rapidity of their military successes, or their descent from Mercury; the helmet is besides sometimes perceived on the heads of coins, particularly in the instances of Alexander and Constantine I.

The Grecian queens have the diadem, and the generality of those of Egypt the sceptre; in some cases placed near the upper part of the head, and in others transversely behind the neck; but the Roman empresses never had the diadem: the most remarkable part of the head-dress of the ladies of the latter nation, was the golden ornament called the sphendona, worn on the crown of the head, and sufficiently large to be noticed on a medal; the hair was dressed as fashion dictated, and the emblematic figure of a crescent sometimes accompanied the bust of an empress.

When the toga is exhibited drawn over the head, the person so represented bore the pontificate or the augurship; the veil, the sign of consecration, is common on the coins of empresses; but those coins are rare and valuable on which emperors are presented in this manner. The more modern saints have now usurped the nimbus or glory with which ancient monarchs adorned their heads. "Havercamp gives a singular coin, which has upon the reverse of the common piece, with the head of Rome, VRBS-ROMA, in large brass, Constantine I. sitting amid victories, and genii, with a triple crown upon his head, for Europe, Asia, and Africa: legend SECVRITAS ROMÆ."

The most usual method of exhibiting portraits on ancient coins was by the bust; but there are instances of half lengths, and even more of the person, in which case the hands are frequently introduced holding emblems of power.

The reverses of medals present an infinite variety of subjects; consequently they afford a proportionate degree of pleasure in the study of them; indeed there is scarcely any peculiarity in the manners, dresses, or religion of the ancients, which they do not serve to illustrate and explain; the habits and symbols of their deities, the allegorical allusions common to their time, their religious ceremonies, the insignia of their magistrates, are given with so much truth, that, added to the historical events they were intended to record, it is impossible to feel indifferent when viewing them; exclusive of these, they furnish matter for curiosity, as sketches of various branches of natural history, by the representations of animals and plants.

A sufficient number of medals has been preserved, of each age, to observe the progress of taste in decorating them, and it appears that the most ancient are without any other mark on the reverse, beyond the indenting of the instrument on which the metal was supported when impressing the obverse; those are four points calculated to secure it firmly: the deformity thus occasioned did not pass unnoticed by the artist and his employer, and invention suggested the insertion of small fish or animals between the points, which were gradually improved upon, till the difficulty was entirely removed, and the figures became beautiful, correct, and highly-finished performances, that will bear critical examination, even furnishing studies for the proportions and muscles of men and animals. The reverses of some Greek medals of great antiquity are concave, and the obverses in a few instances are convex, and the time at which the engravers of their dies became adepts in their art, and capable of making a complete reverse, was about 500 years before Christ. The Romans, sensible of their inferiority to the Greeks in this particular, had the good sense to invite skilful persons to Rome, where they executed the best Roman medals, and taught the artists of that nation to emulate their excellence. None of the above, or Etruscan coins, have been discovered, which are globular, or with an indented reverse similar to those already mentioned; the earliest Greek specimens are universally of silver, whereas the Roman are of copper, cast in moulds, and large, in which they greatly differ from the diminutive size of the Greek.

The Romans seem at first to have been very deficient in composing their reverses, and by no means profited by the rich examples before them: it is, indeed, difficult to account for the constant uniformity and repetition of cars, and prows of gallies, that prevailed till very nearly the Christian era, after which period a variety occurs; and during the reign of the emperors they made ample amends for their previous neglect of this side of the medal. Mr. Pinkerton ob-

serves very justly, "that the medallist much values those which have a number of figures, as the puellæ faustinianæ of Faustina, a gold coin no larger than a sixpence, which has twelve figures; that of Trajan, regna adsignata, has four; the congiarium of Nerva, five; the allocution of Trajan, seven; of Hadrian, ten; of Probus, twelve." There was a felicity of thought, and a happy mode of conveying a compliment, adopted by those who struck medals at the time now under notice, which was accomplished by giving the representation of a virtue, and calling it that of the person commemorated; in this particular the Romans differed greatly from the Greeks; the latter people uniformly pointed out the effigies of their gods and genii by their generally received emblems; but the former inscribed their names. It is entirely useless to particularize the deities and their insignia; but in order to facilitate the study of medals, it may be proper to mention some of the symbols which are not commonly known; branches of plants issuing from vases, for instance, imply a reference to religious games; the serpent springing from a coffer denotes the mystic rites of Bacchus; the anchor on medals infers that they are Seleucian, and struck at Antioch; the tripod was placed, by the Syrian princes, covered and uncovered under the figures of their deities; to which may be added others, in the words of Mr. Pinkerton: "the flowers of pomegranates, for Rhodes; owl, for Athens; pegasus, for Corinth; wolf's head, for Argos; bull's head, for Bœotia; minotaur's head, and the labyrinth, for Crete," &c. &c. Were we to pursue this part of the subject, it would lead to an incredible length of investigation, and it may be doubted whether many mistakes might not be created through the obvious obscurity involving it.

The legends on coins and medals are of too much importance to require a recommendation of their study; the earliest coins of Grecian cities have either the initials, or their names at length; and those of the princes of that country, their names, initials, or monograms. The imperial medals of Greece and Rome are distinguished by methods far more explanatory, as they have words round the face, the reverse, and even in the centre of the latter in some cases. Medallists have divided the inscriptions into three terms, suited to the place of the words; when they encircle the margin they are called the legend; when they occupy the centre of the medal they are called the inscription; and when they are separated from the figure by a line near the bottom, they are on the exergue. The varieties and abundance of legends, &c. precludes a possibility of entering into their merits and peculiarities; some being merely explanatory, cannot be subject either to censure or criticism; others impute virtues, and convey compliments well deserved; but it may justly be doubted, whether the majority do not speak every language except that of truth. One specimen may serve to convince the most incredulous on this head: Julia, the consort of Severus, was termed MAT. AVGG. MAT. SENAT. MAT. PAT., or, the parent of Augustus, the senate, and of her country; but Tiberius became blasphemous, as far as blasphemy could be said to exist in the heathen mythology, by calling himself the *divi filius*. However wanting these legends and inscriptions might be in verity, they must be allowed the merit of beautiful simplicity in their construction, and the most elegant compression.

We have hitherto treated the subject of coins and medals conjointly, which was in a great degree unavoidable, through the similarity of each to the other; for though a coin may be said to be merely intended as a circulating medium, calculated to prevent the difficulties attending the bartering of commodities, yet it has been customary from time immemorial to impress figures on the pieces of metal used for this purpose, of equal import with those stamped on medals intended solely as historical records, or as adulatory offerings to supreme power.

Medallions were made of dimensions far too large for circulation as money, which was necessary in order to give due effect to the design, and to render it intelligible at first view; some were struck as patterns of proposed coins; others were issued at the commencement of a new reign, and on remarkable occasions; and in some instances they may have been the effects of caprice of men in high authority; and in a few cases, of gratitude. It is usual to consider as medals, all those Roman pieces which exceed the denarius aureus in size; those of silver, larger than the denarius; and those of brass, which are of greater diameter than the sestertius; but Mr. Pinkerton is of opinion, "that the gold medallions, weighing two, three, or four aurei only, passed in currency, as the Greek gold didrachms, tridrachms, or tetradrachms, according to their size. The like may be said of the sil-

ver, which are commonly of the value of a Greek tetradrachm: they, I have little doubt, went in currency for four denarii." The brass medallions have the greatest variety of devices on their surfaces, and are executed in a style of superior excellence. Greek pieces of the above description, made before the Roman empire, are extremely rare; but Greek medallions of Roman emperors are far more numerous than the Roman. After the reign of Hadrian, the medallions of that country are seldom found to be of fine workmanship, yet they are invaluable for their rarity, variety, and the intelligence of their devices; these circumstances render them very high-priced.

Besides the superior class of medallions, there are others, particularly of a size between the first and second brass, which the Italians call medaglioncini, and Mr. Pinkerton, medalets, and tokens, and counters, each proceeding from a variety of causes occurring in the Roman dominions. The contorniatii, another kind, are so termed from the hollow circle round them; those are large as medallions, thin, and of inferior execution, and have afforded much latitude for conjecture as to the purpose for which they were intended.

We were under the necessity of dwelling on the foreign coins and medals of antiquity to a considerable extent, that the subject might be fully understood, as we are wholly indebted to the ancients for the invention of money, and even for our designs in many instances. It appears from the account of Britain, written by Cæsar, that the inhabitants at that period had brass and iron money, the use and coinage of which was probably derived from our Gallic neighbours. Cunobelin, to whom many ancient coins found in England have been ascribed, was educated in the court of Augustus, and King of the Trinobantes: those are supposed to be the only extant, purely English, of which there is an admirable collection in our national museum; the legends of them are generally CVNO, and TASCIA, and CAMV; the first seems to apply to Cunobelin, the second has never been explained, and the third may be Camudolanum; the devices are a horse, an ear of wheat, and a bust, accompanied by the abbreviation CVNO, on one side, with a variety of emblems on the other, and CAMV.

English medals, intended entirely as such, were never struck in the ancient periods of our history, and the first known to have been made by order of an Englishman, and stamped on brass, most probably in Italy, was one found in Knaresborough forest, in the seventeenth century, which bears a bust with the legend IO. KENDAL RHODI TVRCVPELLERIVS. MCCCCLXXX. on the obverse, and on the reverse his family arms, and TEMPORE OBSIDIONIS TVRCORVM. MCCCCLXXX. It is singular, that the vast variety of important events which have occurred in England, should have passed away without suggesting this method of perpetuating their remembrance, and that an example should have been set to our monarchs by a knight of Rhodes, who was more affected by the raising of the siege of that island by the Turks, than Edward III. was by his deeds in France. Henry VIII., one of the least worthy of the kings of England, caused a medal to be struck in 1545, which is of considerable diameter, and of gold; the legends of this second British medal are three in number, and are inserted one within the other on the obverse, inclosing his head and face in front; the reverse has two inscriptions, in the Hebrew and Greek languages, which signify his being the defender of the faith, head of the church, &c. The first coronation-medal was that made by order of Edward VI., the son and successor of Henry, whose medal just described served in every respect for a model. Very little can be said in commendation of the execution of these pieces; neither are those of Elizabeth much better, with the exception of one or two. Though earlier in point of time, Philip and Mary were more fortunate in the selection of their artists, particularly Trozzo, who did two in silver for those monarchs, of high relief. Richard Shelly, Prior of the order of St. John of Jerusalem, in England, one of the last who presided at Clerkenwell, caused one to be struck in the reign last mentioned, which deserves praise.

Charles I. a good judge of the arts, exceeded his father, James I. in the excellence of his medals; that dated 1636, representing the King and Henrietta Maria, is finely executed, particularly the heads. "The reverse," observes Mr. Pinkerton, "represents Justice and Peace kissing, awkwardly enough." "The tout ensemble of the piece however is bad, and quite unlike the antique; the standard of perfection in this way, owing to the field of the medal not being above a line thick, while the relievos are a full half inch in thickness: whereas, in the best and boldest ancient

medallions, the edge of the piece is two or three lines thick, where the relief is three or four. A hollowness is, indeed, given in the ancient to the inner field around the relief, both to give more elevation and boldness, and that the edge may something protect the subjects of the field." The medals of Charles would, without doubt, have exceeded all others made by his predecessors, in a very great proportion, had his politics been more successful: still they deserve approbation; though Simon, employed by the Commonwealth and Cromwell, soon after his death surpassed them. Had this celebrated artist received the patronage of the dethroned monarch, in a state of peace, the correctness of his judgment and experience must have produced most superb pieces, which would probably have rivalled those of the Greeks when in the zenith of their fame.

Charles II. had several good medals, particularly the three struck on his leaving Holland, at the Restoration, and at his Coronation. Catherine of Portugal, his consort, decorates some, one of which has her head, and on the reverse *Pietate Insignis*. Mr. Walpole communicated to Mr. Pinkerton, from Vertue's manuscripts, an account of a rare and singular medal, made by command of this licentious monarch, representing the Duchess of Portsmouth on the obverse, and Cupid on a wool-pack on the reverse; besides the above there are the *Favente Deo*; the *Pro talibus ausis*; and the *Felicitas Britanniæ*. The same author adds, "The short reign of James II. has several medals. The most remarkable are the *Nemo me impune lacesset*; that with his queen, *Fortes Radii sed Benigni*; those on the Pretender's birth, *Felicitas Publica*. Others have *Orbata luce lucidum obscurat*; *Magnis interdum parva nocent*; *Pro glandibus Aurea poma*."

The Pretender, though unsuccessful in his attempts to regain the throne of his forefathers, and an exile to the hour of his death, was still so much of an Englishman as to require notice in this article, particularly as his history is a collateral branch of that of England: this Prince caused a medal to be struck by the Papal medallist, Hamerani, on the occassion of his intended consort's escape from the arrest procured by the English minister at Vienna, and which took place in the Tyrol, on her way to the Pretender. The lady was represented on the obverse by her bust, with the legend *Clementina M. Britan. Fr. & Hib. Regina*; and on the reverse she is shewn seated in a chariot, giving the rein to two horses which are drawing it at full speed, the legend *Fortunam Causamque sequor*; and on the exergue, *Deceptis Custodibus*, MDCCXIX. Another medal was struck by him on the birth of his eldest son; this exhibits the busts of the Prince and Princess, with the legend *Jacob. III. R. Clementina R.*; and the reverse has the lady supporting the child on her left arm, which rests on a pillar, an emblem of constancy, the right hand extended points to a globe, presenting England, Scotland, and Ireland, with the legend *Providentia Obstetrix*; the exergue, *Carolo Princ. Valliæ. Nat. Die ultima, A.* M.DCC.XX.

To return from this digression to the time of James II. That weak and unpopular king either caused or permitted malignant medals to be circulated satirizing Monmouth's rebellion, and exulting in his death; the legends on those was *Parum successit feci sedulo*; *superi risere*; *Caput inter nubila*; *Providentia improvidentia, &c.* The reign of William III. was productive of a series of most uncommon events, each of which made admirable subjects for medals; indeed his birth was celebrated by the striking of one, representing his mother on the obverse, and himself in childhood on the reverse. After his accession to the throne of England, he had his own bust and that of Queen Mary almost universally placed on the obverses of his medals, particularly in those known by the following legends; the *Ataius par nobile*; *Atarum pro libertate*; *Nec Lex est justior ulla*; *Nisi tu quis temperit ignes, &c.*: others, which have the king's bust alone, are the *Apparuit et dissipavit*; the *Gul. Nass. in Torbay, &c.*; the *Victis ac fugatis Hibernis*; the *Imperium pelagi nobis*; the *Nunquam impune lacessitus, &c.*

Equally fortunate and prolific in great events was the reign of Anne. This Queen, illustrious in virtue, perpetuated the victories achieved by her armies, under the incomparable Duke of Marlborough, in a regular series of medals; but here we are compelled to cease. Although the subsequent history of this country furnishes repeated occasions for a rich display of medallions, they have nearly been passed unnoticed in this particular; and most of the medals we possess, of modern execution, have been struck by private persons, sometimes to honour the memory of worthy men, but generally to procure present emolument: in the latter class, may be included Dassier,

who engraved and struck a series of all the kings of England, then thirty-six in number, which were executed with great spirit, and are of copper. Dassier was a native of Geneva, and made this addition to English medals about 1740.

The reader will perceive that we have been principally indebted to Mr. Pinkerton's excellent essay on medals for the preceding facts, nor do we hesitate to acknowledge that we shall be equally so for the following sketch of the history of British coins, except some few particulars towards the close of the article. That gentleman observes the heptarchic coins were of two descriptions, one the silver skeatta, or penny, and the copper, or billon styca; the latter was confined to Northumbria, and in the later period of that kingdom the size was diminutive, and the value not more than half a farthing of our money; it is the silver penny therefore which is to be considered as the general coin of the heptarchy, for neither gold or any other kind of silver was issued for a long time after. The admirers of this study are indebted to Dr. Combe for their present knowledge of the skeata, who caused several of them to be engraved; the most ancient have figures of serpents impressed on them, sometimes with the addition of one or two letters, but legends were subsequently introduced: it is obvious, from the symbols, they all belong to the period when the Pagan mythology prevailed. The heptarchic pennies do not occur till after the year 700, though there are skeatas of Ethelbert I. King of Kent, between 560 and 616; and of Egbert, monarch of the same district, anno 664. It is by no means necessary to trace all the coins of the heptarchy, it will be sufficient to say that those of the principal sovereigns exist, almost in a complete series, from Egbert in 832 to Edgar 959; the generality of them have badly executed portraits on the obverse, but the reverses are far more interesting, presenting elevations of cathedrals and other structures, particularly York Minster, on one of Edward, senior, A. D. 900.

The coins of Anlaf, King of Northumbria, bear a raven; Egbert's have the legend *Saxonum* instead of *Anglorum*; and the pennies of Athelstan have *Rex tot. Brit.* Exclusive of these royal coins, there were others purely ecclesiastic, which are extant between 801 and 889, and were struck by several archbishops of Canterbury. Except on the money of Alfred and Edward I. that has towns added, only the names of the moneyers were introduced; from the time of Athelstan, anno 925, the conjunction became general. Neglect or policy prevented William of Normandy from making any alteration in the English penny, and in some instances he adopted the same reverses used by his predecessor, Harold the usurper. This penny possessed many intrinsic qualities, which rendered it more acceptable to the inhabitants of the northern kingdoms, Italy and France, than their own; hence it may be concluded that the commerce of England was extensive even at that remote period, particularly as the first mentioned nations had scarcely any other medium. It is a singular circumstance, and much to the credit of our native land, that it furnishes a complete series of pennies from the reign of Egbert to the present moment, with the exception of those of John and Richard I. whose coins were in the first case Irish, and in the last French; if these monarchs had any struck in England they have not yet been discovered: in this particular we exceed every nation on the globe. The earliest pennies weigh $22\frac{1}{2}$ grains, troy; at the close of the reign of Edward III. they weigh 18 grains, they then fell to 15; and in that of Edward IV. they are 12; Edward VI. reduced the penny to 8 grains; and Elizabeth to $7\frac{31}{32}$. The next coins of antiquity are the halfpennies and farthings, of silver, which were first made permanently by order of Edward I. and continued till the revolution in the time of Charles I.; but the farthings were discontinued after the death of Edward VI. Those were succeeded by the groat piece, introduced by Edward III. and the testoon, or shilling, by Henry VII.; the former term is said to be derived from teste, or tete, the head of the king impressed upon it; the latter evidently comes from the German word schelling. The crown piece, of silver, was first issued by Henry VIII.; and Elizabeth coined three-halfpenny and three farthing pieces, which were not continued by her successors.

Henry VIII. was the first of our monarchs who ventured to debase the money of his realm; and Mr. Pinkerton justly exclaims "it was a debasement indeed! for it extended to 60 per cent:" that issued by him, bearing his profile, is of the ancient standard; but that with his portrait in front, is of the description alluded to. Edward VI. who was the last monarch that had his bust thus represented, exactly re-

versed his father's example, as his coin, with the side face, is bad, and the full face good. The base coin of this king is the first which is dated; the silver coin was restored to the original standard in 1552; and since 1601, 18 pennyweights of alloy has been used in the pound weight.

Henry III. introduced the coinage of gold: his attempt appears, however, to have been unsuccessful, as only two specimens have reached our time, and are called the gold penny; they are larger than that of silver, and tolerably executed: it is to Edward III. therefore we are indebted for the establishment of the system still prevailing, which the last named prince commenced in 1344 with the florens, then worth six shillings, but now greatly increased in value, and thus called from Florence, where the best gold was coined at that period. Half and quarter florens were made at the same time, though none of the former have descended to us. The floren being found inconvenient, from the value not according with a distinct division of larger ideal denominations of money, the noble of 6*s.* 8*d.* was adopted, which consisted of half the mark: this term was founded on the superiority of the metal used in making it, and was attended by other coins of half and quarter nobles; both sides of this money had a circle within it resembling the outline of an open rose, and was thence called the rose noble by medallists. The angels issued by Edward IV. impressed with the figure of the archangel Michael, were of the same value of the noble, and divided in the same way, as they were intended to supersede the former: the increase in the value of gold caused several changes in the weight of the noble; in 1465 the angel, worth 6*s.* 8*d.* weighed 80 grains, to which it had fallen from 120 grains, the weight of the original noble of 6*s.* 8*d.* The ryal, of the value of 10*s.* and the angel, with its divisions, were the only English gold coins till 1485; but Henry VII. ordered the coinage of a double ryal, value 20*s.* and the double sovereign of 40*s.* Henry VIII. added the gold crown and half crown, of 5*s.* and 2*s.* 6*d.*; and issued sovereigns of 22*s.* 6*d.*; ryals of 11*s.* 3*d.*; angels of 7*s.* 6*d.*; and nobles of 6*s.* 8*d.*: this monarch, after raising the value of silver to the proportion of 1 to 5 of gold, issued sovereigns of 20*s.*

Previous to the reign of Edward VI. the figures of our kings were represented on their gold coin at full and three quarters length, but the young king introduced himself in a bust: in his reign silver, which had been as 1 to 4, was reduced to the ancient proportion of 1 to 11. James I. gave the sovereign the name of unite, in honour of the union of England and Scotland in his person, which were then 20*s.*; and he made rose ryals of 30*s.*; and spur ryals 1*l.* 15*s.*; angels of 10*s.*; angelets of 5*s.*: and in the ninth year of his reign gold was raised in the proportion of one shilling.

We shall now turn our attention to some other unquestionable authorities for the further illustration of this interesting subject. James, aware of the variety of causes which operated to injure and annihilate the circulating medium, as such, issued a proclamation in 1619, prohibiting the exchange of monies for profit, the making of plate of any of his majesty's coins, and the excessive use of gold and silver foliate. Charles I. devoted much of his attention, in the early part of his reign, to the state of the coinage, and published several commissions for regulating of it, amongst which was one for stamping all bullion of gold and silver brought into the kingdom, and another for reforming abuses and frauds committed in the silver coin. This explains the previous manner of proceeding, and asserts that the exchange of all kinds of gold and silver fit for the mint, one of the kings prerogatives, had been entrusted to the goldsmiths, who had abused this indulgence, and by presuming to sort and weigh every description of money, daily selecting the heaviest for melting, or for sale to persons who exported it immediately, thus materially diminishing the quantity of current coin, and rendering those who brought silver to the mint certain losers. The proclamation alluded to appointed Henry, Earl of Holland, superintendant of the changes, exchanges, and outchanges, in the British dominions; and prohibited the exportation of gold or silver, either coined or otherwise, and the melting of the coin, besides providing for the reformation of the abuses committed by goldsmiths, who upon the sale of their wares were to demand for value or rate separately, and the fashion and workmanship separately; and were commanded at the same time to give a memorandum to the purchaser, describing the day of sale, the weight, the value of the metal, and the charge for fashion, &c. by which means the buyer, on selling the same again, might know what to demand for it at the king's exchange or mint.

Another remarkable event occurred in this reign relating to the subject under notice, which was a proclamation commanding the currency of the French silver coin called cardecue, at its original value: to render this measure acceptable, Charles accounts for it by saying he had received a large sum in the coin mentioned, as the queen's portion, which he had intended to have recoined, but the plague intervening he conceived the measure necessary: this order was soon after revoked for obvious reasons. The year 1631 produced "A special commission for making trial of the experience, skill, and industry, of Nicholas Bryatt, (a native of Lorrain) in the coinage of money at the mint," who proposed, by means of his instruments, mills, and presses, to make far better impressions from well engraved figures, and with less expense than had been the case by the usual way of hammering; and in the next year a patent passed the privy seal, granting to Sir Thomas Aylesbury the making of all the weights, and licensing all the balances for the gold coin of England; at which period, according to Rushworth, there was so great a glut of gold, and so great a scarcity of silver in the kingdom, that the drovers and farmers who attended the market in Smithfield were under the necessity of stipulating that their payments for sales should be made in the latter metal; two-pence, and often much more, was at the same time allowed in procuring change for twenty shillings. In consequence of the patent just mentioned, the public were generally provided, individually, with the gold scales issued by Sir Thomas Aylesbury.

One of the last acts of the unfortunate Charles was a prohibition of converting coin, plate, or bullion, into gold and silver thread.

The Commonwealth made ten and five shilling pieces of gold, and Oliver Cromwell issued a few forty and twenty shilling pieces. Charles II. ordered the coinage of the guinea, which was so named from the gold of which they were made being imported from Guinea; these were published originally for twenty shillings, but they were ever received at twenty-one, and are 22 carats fine and 2 alloy, the present standard. Besides the guinea, Charles issued five guinea pieces, double guineas, and half guineas, an example followed by the succeeding monarchs, of whom George I. and the present monarch, published quarter guineas: the latter seven shilling pieces, which are convenient.

It now only remains to notice the copper coins of the realm. The first on record are the Saxon stycas, of which Mr. Pinkerton remarks they are rather billon than copper; the idea and form of this money was evidently derived from the Roman denarius, and the cutting of them into four parts, through the division of a cross stamped on them, produced farthings.

Previous to the time of Queen Elizabeth the public was reduced to the necessity of issuing tokens in order to obtain the means of carrying on the necessary trading intercourse; and, however strange it may appear, that so enlightened a princess should commit so great an error of judgment, she never could be prevailed upon to issue a copper coinage; an attempt, indeed, occurred, and a pattern piece appeared with the queen's monogram on one side and a rose on the other, with a running legend adapted to each—of "the pledge of—a halfpenny," but the scheme died away. The royal farthings of James I. were afterwards issued, though with little success, as he did not make them legal tender.

Charles I. published a proclamation in 1625, for the continuance of farthing tokens of copper, prohibiting all persons from counterfeiting them, or the use of any others; and the patent for this coinage was granted to Sir Francis Crane, and Frances, Duchess Dowager of Lenox, who by a subsequent instrument were to have the exclusive power and profit for seventeen years, on paying 100 marks per annum. into the royal treasury; they further promised to return 21*s.* in farthings for every 20*s.* sterling, and to deliver 20*s.* sterling for every 21*s.* worth of farthings, to those who were overstocked with them. The obverse of this coin was to have an impression of two sceptres crossed under a diadem, and the reverse a harp crowned, and the legend *Carolus Dei Gratia Magnæ Britanniæ, Franciæ, & Hiberniæ, Rex.*

In the year 1636, the crown granted to Henry, Lord Maltravers, and Sir Francis Crane, a patent for the coinage of farthings, but this coin was not made a legal tender to the poor. The civil war, which occurred soon after, reduced the generality of tradesmen to the necessity of again having recourse to tokens, and these were issued to a degree beyond precedent; the existing government appears, however, to have been sensi-

ble of the difficulties attending the want of copper money, and made some abortive attempts to supply the deficiency. Charles II. caused the making of halfpence and farthings at the Tower, in 1670, but their circulation, by proclamation, did not take place till two years after; these were of pure Swedish copper, from dies engraved by Roethier. Their progress through the hands of the public was uninterrupted till 1684, when they were dropped on account of some disputes arising concerning the use of British copper: after this period there was a coinage of tin farthings, which contained a centre of copper, and the inscription *Nummorum Famulus*, 1685-1686; halfpence of the same description were issued in the next year, and copper was not adopted again till 1693, at which time all the tin money was called in. Mr. Pinkerton closes his accurate observations on this subject, by saying, "All the farthings of the following reign of Anne are trial-pieces, save that of 1714, her last year. They are of the most exquisite workmanship, exceeding most copper coins of ancient or of modern time, and will do honour to the engraver, Mr. Croker, to the end of time. The one whose reverse is Peace in a car, *Pax missa per Orbem*, is the most esteemed; and next to it the Britannia under a portal; the other farthings are not so valuable.

The copper coins of the succeeding reigns, up to the present, are tolerably executed, and those really from the royal mint are of excellent copper; but the extreme smallness of them offered such inducements to forgery that the country was inundated by thousands of base imitations, which would be disgraceful to the most barbarous nations. Aware of the stigma attending this shameful state of the public money, government recently issued two-penny, penny, halfpenny, and farthing pieces of the best copper, which were badly executed, and so extremely clumsy and inconvenient that they excited general discontent; this disapprobation did not, however, long continue, for the price of copper rising considerably the coins were universally melted by speculators, and they were replaced by the present reduced pieces of pence, halfpence, and farthings, which are neat and tolerably convenient. The silver is in a shocking state of decay from wear; even that from the mint; but of the shillings in constant circulation not a fiftieth part are genuine, and not a thousandth part of the sixpences; indeed, the latter are beneath notice as a coin.

MEDALLION, or MEDALION, a medal of an extraordinary size, supposed to be anciently struck by the emperors for their friends, and for foreign princes and ambassadors; but that the smallness of their number might endanger the loss of the devices they bore, the Romans generally took care to stamp the subject of them upon their ordinary coins.

Medallions, in respect of the other coins, were the same as modern medals in respect of modern money: they were exempted from all commerce, and had no other value but what was set upon them by the fancy of the owner.

MEDEOLA, in botany, a genus of the Hexandria Trigynia class and order. Natural order of Sarmentaceæ. Asparagi, Jussieu. Essential character: calyx none; corolla, six parted revolute; berry three seeded. There are three species, natives of the Cape of Good Hope.

MEDICAGO, in botany, *medick* or *trefoil*, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ or Leguminosæ. Essential character: legume compressed, bent in; keel bent down from the banner. There are eleven species. These are chiefly herbs; the leaves commonly ternate; stipules small, fastened to the bottom of the petiole; peduncles axillary and terminating, one or many-flowered in spikes or glomerate. M. sativa, cultivated medick or lucern, is a valuable plant; it has a perennial root, with annual stalks, smooth and striated, about two feet in height; leaves ternate; leaflets elliptic, entire at the base. The common colour of the flower is a fine violet purple. For a full and clear description of this genus the reader is referred to Martyn's edition of Millar's Botany.

MEDICINE, the healing art, or science of therapeutics. In this extensive and general sense, it includes the Materia Medica, or substances employed in medicine; Pharmacy, or the mode of compounding them; and Praxis, or the phænomena of diseases and practice of medicine. In a more limited, and perhaps a more correct sense, however, the term is confined to the last division: and in this sense alone we shall understand it in the present instance, referring the reader to the article MATERIA MEDICA for the substances employed in the art of healing, and to the article PHARMACY for the mode of compounding them, and their

respective results in a state of combination.

HISTORY OF MEDICINE.

The commencement of the medical profession, whether regarded as an art or a science, or both, is lost in the darkness of the earliest ages; the fabulous history of the ancients derives it immediately from their gods; and, even among the moderns, some writers of established reputation are of opinion that it may justly be considered as of divine origin; but, without adopting any supposition of which no probable evidence can be given, we may conclude that mankind were naturally led to it from casual observations on the diseases to which they found themselves subjected, and that therefore, in one sense at least, it is as ancient as the human race; but at what period it began to be practised as an art, by particular individuals following it professionally, is not known. The most ancient physicians we read of were those who embalmed the body of the patriarch Jacob by order of his son Joseph; the sacred writer styles these physicians servants to Joseph, whence we may be assured that they were not priests, as the first physicians are generally supposed to have been; for in that age we know the Egyptian priests were in such high favour, that they retained their liberty, when through a public calamity all the rest of the people were made slaves to the prince; it is not probable, therefore, that, among the Egyptians, religion and medicine were originally conjoined; and if we suppose the Jews not to have invented the art, but to have received it from some other nation, it is as little probable that the priests of that nation were their physicians, as those of Egypt. That the Jewish physicians were absolutely distinct from their priests, is very certain. Yet as the Jews resided for such a long time in Egypt, it is probable they would retain many of the Egyptian customs, from which it would be very difficult to free them: we read, however, that when king Asa was diseased in his feet, he sought not to the Lord, but to the physicians; hence we may conclude, that among the Jews the medicinal art was looked upon as a mere human invention; and it was thought that the deity never cured diseases by making people acquainted with the virtues of herbs, but only by his miraculous power. That the same opinion prevailed among the heathens who were neighbours to the Jews, is also probable from what we read of Ahaziah king of Judah, who having sent messengers to inquire of Baalzebub, god of Ekron, concerning his disease, did not desire any remedy from him or his priests, but simply to know whether he should recover or not; what seems most probable on this subject therefore is, that religion and medicine intermixed themselves only in consequence of that degeneracy into ignorance and superstition, which took place among all nations.

The Egyptians, we know, came at last to be sunk in the most ridiculous and absurd superstition; and then, indeed, it is not wonderful to find their priests commencing physicians, and mingling charms, incantations, &c. with their remedies. That this was the case, though long after the days of Joseph, we are very certain, and indeed it seems as natural for ignorance and barbarism to combine religion with physic, as it is for a civilized and enlightened people to keep them separate; hence, we see that among all modern barbarians their priests or conjurors are their only physicians. We are so little acquainted with the state of physic among the Egyptians, that it is needless to say much concerning them. They attributed the invention of medicine, as they did also that of many other arts, to Thoth, the Hermes or Mercury of the Greeks; he is said to have written many things in hieroglyphic characters upon certain pillars, in order to perpetuate his knowledge, and render it useful to others. These were transcribed by Agathodemon, or the second Mercury, the father of Tent, who is said to have composed books of them, that were kept in the most sacred places of the Egyptian temples. The existence of such a person, however, is very dubious, and many of the books ascribed to him were accounted forgeries as long ago as the days of Galen; there is also great reason to suspect, that those books were written many ages after Hermes, and when physic had made considerable advances. Many of the books attributed to him are trifling and ridiculous; and though sometimes he is allowed to have all the honour of inventing the art, he is, on other occasions, obliged to share it with Osiris, Isis, and Apis, or Serapis. After all, the Egyptian physic appears to have been little else than a collection of absurd superstitions. Origen informs us, that they believed there were thirty-six demons or gods of the air, who divided the human body among them;

that they had names for all of them; and that by invoking them according to the part affected, the patient was cured.

Of natural medicine we hear of none recommended by the father of Egyptian physic, except the herb moly, which he gave to Ulysses in order to secure him from the enchantments of Circe; and the herb mercury, of which he first discovered the use. His successors employed venesection, carthartics, emetics, and clysters; there is no proof, however that this practice was established by Hermes; on the contrary, the Egyptians themselves pretended, that the first hint of those remedies was taken from some observations on brute animals. Venesection was taught them by the Hippopotamus, which is said to perform this operation upon itself; on these occasions, he comes out of the river, and strikes his leg against a sharp pointed reed; as he takes care to direct the stroke against a vein, the consequence must be a considerable effusion of blood; and this being suffered to run as long as the creature thinks proper, he at last stops up the orifice with mud. The hint of clysters was taken from the ibis, a bird which is said to give itself clysters with its bill, &c. they used venesection, however, but very little, probably on account of the warmth of the climate; and the exhibition of the remedies above mentioned, joined with abstinence, formed most of their practice.

The Greeks too had several persons to whom they attributed the invention of physic, particularly Prometheus, Apollo or Pæan, and Æsculapius; which last was the most celebrated of any; but here we must observe, that as the Greeks were a very warlike people, their physic seems to be little else than what is now called surgery, or the cure of wounds, fractures, &c.; hence Æsculapius, and his pupils Chiron, Machaon, and Podalirius, are celebrated by Homer only for their skill in curing these, without any mention of their attempting the cure of internal diseases. We are not, however, to suppose that they confined themselves entirely to surgery; they no doubt would occasionally prescribe for internal disorders, but as they were most frequently conversant with wounds, we may naturally suppose the greatest part of their skill to have consisted in knowing how to cure these. If we may believe the poets, indeed, the knowledge of medicine seems to have been very generally diffused.

Almost all the heroes of antiquity are reported to have been physicians as well as warriors. Most of them were taught physic by the Centaur Chiron, from him Hercules received instructions in the medicinal art, in which he is said to have been no less expert than in feats of arms. Several plants were called by his name; from whence some think it probable that he found out their virtues, though others are of opinion that they bore the name of this renowned hero, on account of their great efficacy in removing diseases. Aristæus, King of Arcadia, was also one of Chiron's scholars, and supposed to have discovered the use of the drug called silphium, by some thought to be asafœtida.

Theseus, Telamon, Jason, Peleus, and his son Achilles, were all renowned for their knowledge in the art of physic, the last is said to have discovered the use of verdigris in cleansing foul ulcers. All of them, however, seem to have been inferior in knowledge to Palamedes, who prevented the plague from coming into the Grecian camp, after it had ravaged most of the cities of Hellespont, and even Troy itself. His method was to confine his soldiers to a spare diet, and oblige them to use much exercise.

The practice of these ancient Greek physicians, notwithstanding the praises bestowed upon them by their poets, seems to have been very limited, and in some cases even pernicious. All the external remedies applied to Homer's wounded heroes were fomentations; while, inwardly, their physicians gave them wine, sometimes mingled with cheese scraped down; a great deal of their physic also consisted in charms, incantations, amulets, &c. of which, as they are common to all superstitious and ignorant nations, it is superfluous to take any further notice. In this way the art of medicine continued among the Greeks for many ages. As its first professors knew nothing of the animal economy, and as little of the theory of diseases, it is plain, that whatever they did must have been in consequence of mere random trials, or empiricism, in the most strict and proper sense of the word. Indeed, it is evidently impossible that this, or almost any other art, could originate from any other source than trials of this kind: accordingly, we find, that some ancient nations were accustomed to expose their sick in temples, and by the sides of highways, that they might receive the advice of every one who passed.

Among the Greeks, however, Æsculapius, was reckoned the most eminent practitioner of his time, and his name continued to be revered after his death. He was ranked amongst the gods; and the principal knowledge of the medicinal art remained with his family to the time of Hippocrates, who reckoned himself the seventeenth in a lineal descent from Æsculapius, and who was truly the first who treated of medicine in a regular and rational manner.

Hippocrates, who is supposed to have lived four hundred years before the birth of Christ, is the most ancient author whose writings have descended to the present day: and he is hence justly regarded as the father of medicine. In his period, and indeed till a centnry or two ago, the distinct branches of medicine and surgery were studied and practised by the same person. Hippocrates, therefore, has been universally regarded as having contributed equally to our physiological and anatomical knowledge of the human frame, and the few anecdotes relating to him for which we can find room, has been already communicated to the reader under the article ANATOMY. We shall here therefore only add those opinions of the Coan sage, which more immediately apply to the science of therapeutics, and which are most entitled to general attention.

As far as Hippocrates attempts to explain the causes of disease, he refers much to the humours of the body, particularly to the blood and the bile. He treats also of the effects of sleep, watchings, exercise, and rest, and all the benefit or mischief we may receive from them; of all the causes of diseases, however, mentioned by Hippocrates, the most general are diet and air. On the subject of diet he has composed several books, and in the choice of this he was exactly careful; and the more so, as his practice turned almost wholly upon it. He also considered the air very much, he examined what winds blew ordinarily or extraordinarily; he considered the irregularity of the seasons, the rising and setting of the stars, or the time of certain constellations; also the time of the solstices, and of the equinoxes, those days, in his opinion, producing great alterations in certain distempers; he does not, however, pretend to explain how, from these causes, that variety of diseases arises which is daily to be observed. All that can be gathered from him with regard to this is, that the different causes above mentioned, when applied to the different parts of the body, produce a great variety of disorders; some of these he accounted mortal, others dangerous, and the rest easily curable, according to the cause from whence they spring, and the parts on which they fall: in several places, also, he distinguishes diseases, from the time of their duration, into acute or short, and chronical or long. He likewise distinguishes diseases by the particular places where they prevail whether ordinary or extraordinary. The first, that is, those that are frequent and familiar to certain places, he called endemic diseases; and the latter, which ravaged extraordinarily, sometimes in one place, sometimes in another, which seized great numbers at certain times, he called epidemic, that is, popular diseases; and of this kind the most terrible is the plague. He likewise mentions a third kind, the opposite of the former; and these he calls sporadic, or straggling diseases: these last include all the different sorts of distempers which invade any one season, which are sometimes of one sort and sometimes of another. He distinguished between those diseases which are hereditary, or born with us, and those which are contracted afterwards; and likewise between those of a kindly, and such as are of a malignant nature; the former of which are easily and frequently cured, while the latter give physicians a great deal of trouble, and are seldom overcome by all their care.

A foundation for the theory and practice of medicine being thus laid, the science was pursued with great avidity by Praxagoras, who nevertheless ventured, in some respects, to oppose the practice of Hippocrates, and by Erasistratus and Herophilus, of whom the last, as a disciple of Praxagoras, inclined rather to the Praxagorean than the Hippocratic school. Erasistratus, however, acquired a higher fame, though a more steady adherent to the older and Hippocratic doctrines, and to him we are indebted for the first regular indications of the pulse.

About this period the profession of medicine began to be divided into the three branches of dietetic, pharmaceutic, and chirurgic; or those who pretended to cure by regimen alone, disregarding, and even despising, pharmacy; those who undertook to cure chiefly by pharmaceutic preparations (of which number was Erasistratus himself), and those who devoted their whole time and attention to the chirurgical department of the medical art.

The next division of medical practitioners

was into that of dogmatists and empyrics; the latter having commenced with Serapion of Alexandria, about the year 287 before Christ, who, according to Galen, retained the mode of practice of Hippocrates, but pretended to despise his mode of reasoning. In reality this sect, to which Serapion belonged, and of which, if not the founder, he was a very zealous supporter in its earliest infancy, depended upon their own personal experience alone, whether progressive or fortuitous. On the contrary, the dogmatists affirmed, that there is a necessity for knowing the latent as well as the evident causes of diseases, and that physicians ought to understand the natural actions and functions of the human body, and consequently its internal organs.

The physicians of chief fame who flourished subsequently to this division, were Asclepiades, who opposed the Hippocratic theory of natural power and sympathy, or attraction, by engrafting upon medicine the physical principles of the Epicurean philosophy: Themison, the founder of the methodic sect, whose doctrines evinced equal hostility to the dogmatists and empyrics, and divided diseases into the two classes of hypertonic and atonic, a division which in various modifications has descended to the present day: Thessalus, contemporary with Nero, a man of some merit, but of inordinate vanity; and Celsus, deservedly denominated the Latin Hippocrates, whose work is equally valuable for the purity of its language, and the knowledge it communicates of the state of medicine at the time he wrote.

About the year after Christ 131, in the reign of Adrian, appeared the celebrated Galen, whose name makes so conspicuous an appearance in the history of physic. Practitioners were at this time divided into the three sections of methodists, dogmatists, and empyrics. Galen inclined to the second party, but with a true eclectic spirit undertook to combine with its doctrine whatever existed of real worth in the two adverse systems; and hence, to reform and give a finish to the science of medicine beyond what it had ever possessed before. For the most part he was a follower of Hippocrates, whose name he revered, and whose opinions he commented upon; asserting in the course of his comments that he had never been thoroughly understood before. Like Hippocrates, he denominated the vital principle nature; like him he admitted the existence of four distinct humours, from the predominancy, or deficiency, or disproportion of which, originates the different temperaments of the animal frame, and the varieties in the different diseases to which it is subject: these humours are the blood, phlegm, yellow and black bile. He likewise established three distinct kinds of auras, gases, or spirits, a natural, a vital, and an animal, which he regarded as so many instruments to distinct faculties; referring the seat and action of the first chiefly to the liver, of the second to the heart, of the third to the brain. His authority, in spite of all the fancies which are interwoven into his system, continued to prevail till the overthrow of the Roman empire, and learning and the arts were transferred to the eastern empire: under the auspices of which, however, the science of medicine does not appear to have made any progress; the Saracenic physicians totally neglecting the study of anatomy and every other auxiliary pursuit, and merely adding to the Materia Medica a variety of plants, whose names we now seldom hear of, and whose pharmaceutic virtues have long been despised and forgotten.

From the period at which we are now arrived, till the commencement of the sixteenth century, the history of medicine furnishes no particulars of interest. It was this epoch that gave birth to Paracelsus, who having plunged deeply into the science of alchemy, if such a term as science be not prostituted by an application to such a subject, proscribing by one broad sweep all the reasonings of the ancient authors, endeavoured to explain all the facts and doctrines of medicine upon the principles of the fashionable science of the day.

It was in 1628 that medicine acquired a knowledge of the momentous fact of the circulation of the blood, through the indefatigable labours of Dr. W. Harvey, who nevertheless had to struggle for years against a double torrent of nearly equal violence, before the jealousies and prejudices of the profession were completely mastered: some denying the fact altogether, and others contending that it was a point that had been ascertained for ages, and consequently that he was by no means entitled to the honour of the discovery. The establishment of this important fact, however, did not, even for a long period after its general admission, produce all the advantages which might have been expected from it. For the physiologists of the day, in reasoning upon the powers by which this phœnomenon, as well

as various others of the animal frame was accomplished, unfortunately took hold of the mechanical philosophy as their guide; and every function was immediately attempted to be explained by the laws of projectiles, till the system at length destroyed itself by the absurdity of the extent to which it was pushed.

Boerhaave, at this period, led the way to an admirable reformation, both of principle and practice; and by uniting the doctrines of Hippocrates with the philosophy of the times, framed a theory of medicine upon the supposition of acrimony, lentor, and other changes in the circulating fluids.

Contemporary with Boerhaave were Hoffman and Stahl; both of whom deviating from the theory of Boerhaave, the first laid the foundation of the spasmodic hypothesis, by resolving the origin of all diseases into an universal atony, or an universal spasm in the primary moving powers of the system; and the second into the action of certain noxious agents, controlled, however, by the internal existence of a rational soul that directs the entire economy. The humoral pathology, nevertheless, continued to prevail, till, under the auspices of Dr. Cullen, the theories of Hoffman and Stahl were united into one common and ingenious system; a system which still holds its ground, though it has been since controverted by the sensorial hypothesis of Dr. Brown and Dr. Darwin.

NOSOLOGY.

In order to reduce the practice of medicine to something definite, to simplify what was perplexed, and to lay down certain general rules for a more accurate investigation of diseases, physicians in all ages have attempted to arrange these last into a systematized form; and the works which have thus treated of diseases, are entitled Nosologies. We cannot enter into an examination of those which have progressively been offered to the world in former periods, for this would carry us far beyond the limits prescribed by a Cyclopædia of any extent; yet while we are compelled to pass by the different arrangements of the Greeks and Romans, of the Arabians, the earlier Italians, and Germans, we cannot consent to relinquish a survey of those which are chiefly appealed to in the present day, and under which the art and science of medicine are generally taught in our public schools. We shall, for this purpose, select the five following, as affording a sufficient scope for comparison, and as offering the best arrangements of diseases which have hitherto been presented to the world: these five comprehend the nosological systems of Cullen, Sauvage, Linnæus, Vogel, and Sagar; and we shall exhibit them in their respective classes, orders, and genera.

Nosological Arrangement of CULLEN.

CLASS I. PYREXIÆ.

ORDER I. FEBRES.

§ 1. *Intermittentes.*	§ 2. *Continuæ.*
1. Tertiana	4. Synocha
2. Quartana	5. Typhus
3. Quotidiana	6. Synochus

ORDER II. PHLEGMASIÆ.

7. Phlogosis	16. Hepatitis
8. Ophthalmia	17. Splenitis
9. Phrenitis	18. Nephritis
10. Cynanche	19. Cystitis
11. Pneumonia	20. Hysteritis
12. Carditis	21. Rheumatismus
13. Peritonitis	22. Odontalgia
14. Gastritis	23. Podagra
15. Enteritis	24. Arthropuosis

ORDER III. EXANTHEMATA.

25. Variola	30. Erysipelas
26. Varicella	31. Miliaria
27. Rubeola	32. Urticaria
28. Scarlatina	33. Pemphigus
29. Pestis	34. Aphtha

ORDER IV. HÆMORRHAGIÆ.

35. Epistaxis	37. Hæmorrhois
36. Hæmoptysis	38. Menorrhagia

ORDER V. PROFLUVIA.

39. Catarrhus	40. Dysenteria

CLASS II. NEUROSES.

ORDER I. COMATA.

41. Apoplexia	42. Paralysis

ORDER II. ADYNAMIÆ.

43. Syncope	45. Hypochondriasis
44. Dyspepsia	46. Chlorosis

ORDER III. SPASMI.

47. Tetanus	51. Raphania
48. Trismus	52. Epilepsia
49. Convulsio	53. Palpitatio
50. Chorea	54. Asthma

55. Dyspnœa
56. Pertussis
57. Pyrosis
58. Cholica
59. Cholera
60. Diarrhœa
61. Diabetes
62. Hysteria
63. Hydrophobia

ORDER IV. VESANIÆ.

64. Amentia
65. Melancholia
66. Mania
67. Oneyrodynia

CLASS III. CACHEXIÆ.

ORDER I. MARCORES.

68. Tabes
69. Atrophia

ORDER II. INTUMESCENTIÆ.

§ 1. *Adiposæ.*
70. Polysarcia
§ 2. *Flatuosæ.*
71. Pneumatosis
72. Tympanites
73. Physometra
§ 3. *Aquosæ.*
74. Anasarca
75. Hydrocephalus
76. Hydrorachitis
77. Hydrothorax
78. Ascites
79. Hydrometa
80. Hydrocele
§ 4. *Solidæ.*
81. Physconia
82. Rachitis

ORDER III. IMPETIGINES.

83. Scrophula
84. Syphilis
85. Scorbutus
86. Elephantiasis
87. Lepra
88. Frambesia
89. Trichoma
90. Icterus

CLASS IV. LOCALES.

ORDER I. DYSÆSTHESIÆ.

91. Caligo
92. Amaurosis
93. Dysopia
94. Pseudoblepsis
95. Dysecœa
96. Paracusis
97. Anosmia
98. Agheustia
99. Anæsthesia

ORDER II. DYSOREXIÆ.

§ 1. *Appetitus erronei.*
100. Bulimia
101. Polydipsia
102. Pica
103. Satyriasis
104. Nymphomania
105. Nostalgia
§ 2. *Appetitus deficientes.*
106. Anorexia
107. Adipsia
108. Anaphrodisia

ORDER III. DYSCINESIÆ.

109. Aphonia
110. Mutitas
111. Paraphonia
112. Psellismus
113. Strabismus
114. Dysphagia
115. Contractura

ORDER IV. APOCENOSES.

116. Profusio
117. Ephidrosis
118. Epiphora
119. Ptyalismus
120. Enuresis
121. Gonorrhœa

ORDER V. EPISCHESES.

122. Obstipatio
123. Ischuria
124. Dysuria
125. Dyspermatismus
126. Amenorrhœa

ORDER VI. TUMORES.

127. Aneurisma
128. Varix
129. Ecchymoma
130. Schirrus
131. Cancer
132. Bubo
133. Sarcoma
134. Veruca
135. Clavus
136. Lupia
137. Ganglion
138. Hydatis
139. Hydarthrus
140. Exostosis

ORDER VII. ECTOPIÆ.

141. Hernia
142. Prolapsus
143. Luxatio

ORDER VIII. DIALYSES.

144. Vulnus
145. Ulcus
146. Herpes
147. Tinea
148. Psora
149. Fractura
150. Caries

Nosological Arrangement of SAUVAGE.

CLASS I. VITIA.

ORDER I. MACULÆ.

Genus 1. Leucoma
2. Vitiligo
3. Ephelis
4. Gutta rosea
5. Nævus
6. Ecchymoma

ORDER II. EFFLORESCENTIÆ.

7. Herpes
8. Epinictis
9. Psydracia
10. Hidroa

ORDER III. PHYMATA.

11. Erythema
12. Œdema
13. Emphysema
14. Scirrhus
15. Phlegmone
16. Bubo
17. Parotis
18. Furunculus
19. Anthrax
20. Cancer
21. Paronychia
22. Phimosis

ORDER IV. EXCRESCENTIÆ.

23. Sarcoma
24. Condyloma
25. Verruca
26. Pterygium
27. Hordeolum
28. Bronchocele
29. Exostosis
30. Gibbositas
31. Lordosis

ORDER V. CYSTIDES.

32. Aneurisma
33. Varix
34. Hydatis
35. Marisca
36. Staphyloma
37. Lupia
38. Hydrarthus
39. Apostema
40. Exomphalus
41. Oscheocele

ORDER VI. ECTOPIÆ.

42. Exophthalmia	44. Hypostophyle
43. Blepharoptosis	45. Paraglossa

ORDER VI. ECTOPIÆ.

46. Proptoma	55. Hysterocele
47. Exania	56. Cystocele
48. Exocyste	57. Encephalocele
49. Hysteroptosis	58. Hysteroloxia
50. Enterocele	59. Parorchydium
51. Epiplocele	60. Exarthrema
52. Gasterocele	61. Diastasis
53. Hepatocele	62. Laxarthrus
54. Splenocele	

ORDER VII. PLAGÆ.

63. Vulnus	71. Ulcus
64. Punctura	72. Exulceratio
65. Excoriatio	73. Sinus
66. Contusio	74. Fistula
67. Fractura	75. Rhagus
68. Fissura	76. Eschara
69. Ruptura	77. Caries
70. Amputatura	78. Arthrocace

CLASS II. FEBRES.

ORDER I. CONTINUÆ.

79. Ephemera	82. Typhus
80. Synocha	83. Hectica
81. Synochus	

ORDER II. REMITTENTES.

84. Amphimerina	86. Tetartophya
85. Tritæophya	

ORDER III. INTERMITTENTES.

87. Quotidiana	89. Quartana
88. Tertiana	90. Erratica

CLASS III. PHLEGMASIÆ.

ORDER I. EXANTHEMATICÆ.

91. Pestis	96. Purpura
92. Variola	97. Erysipelas
93. Pemphigus	98. Scarlatina
94. Rubeola	99. Essera
95. Miliaris	100. Aphtha

ORDER II. MEMBRANACEÆ.

101. Phrenitis	105. Enteritis
102. Paraphrenesis	106. Epiploitis
103. Pleuritis	107. Metritis
104. Gastritis	108. Cystitis

ORDER III. PARENCHYMATOSÆ.

109. Cephalitis	113. Hepatitis
110. Cynanche	114. Splenitis
111. Carditis	115. Nephritis
112. Peripneumonia	

CLASS IV. SPASMI.

ORDER I. TONICI PARTIALES.

116. Strabismus	119. Contractura
117. Trismus	120. Crampus
118. Obstipitas	121. Priapismus

ORDER II. TONICI GENERALES.

122. Tetanus	123. Catochus

ORDER III. CLONICI PARTIALES.

124. Nystagmus	128. Convulsio
125. Carphologia	129. Tremor
126. Pandiculatio	130. Palpitatio
127. Apomytosis	131. Claudicatio

ORDER IV. CLONICI GENERALES.

132. Rigor	135. Hysteria
133. Eclampsia	136. Scelotyrbe
134. Epilepsia	137. Beriberia

CLASS V. ANHELATIONES.

ORDER I. SPASMODICÆ.

138. Ephialtes	141. Singultus
139. Sternutatio	142. Tussis
140. Oscedo	

ORDER II. OPPRESSIVÆ.

143. Stertor	148. Pleurodyne
144. Dyspnœa	149. Rheuma
145. Asthma	150. Hydrothorax
146. Orthopnœa	151. Empyema
147. Angina	

CLASS VI. DEBILITATES.

ORDER I. DYSÆSTHESIÆ.

152. Cataracta	157. Agheustia
153. Caligo	158. Dysecœa
154. Amblyopia	159. Paracusis
155. Amaurosis	160. Cophosis
156. Anosmia	161. Anæsthesia

ORDER II. ANEPITHYMIÆ.

162. Anorexia	164. Anaphrodisia
163. Anipsia	

ORDER III. DYSCINESIÆ.

165. Mutitas	169. Paralysis
166. Aphonia	170. Hemiplegia
167. Psellismus	171. Paraplexia
168. Paraphonia	

ORDER IV. LEIPOPSYCHIÆ.

172. Asthenia	174. Syncope
173. Leipothymia	175. Asphyxia

ORDER V. COMATA.

176. Catalepsis
177. Ecstasis
178. Typhomania
179. Lethargus
180. Cataphora
181. Carus
182. Apoplexia

CLASS VII. DOLORES.

ORDER I. VAGI.

183. Arthritis
184. Ostocopus
185. Rhumatismus
186. Catarrhus
187. Anxietas
188. Lassitudo
189. Stupor
190. Pruritus
191. Algor
192. Ardor

ORDER II. CAPITIS.

193. Cephalalgia
194. Cephalæa
195. Hemicrania
196. Ophthalmia
197. Otalgia
198. Odontalgia

ORDER III. PECTORIS.

199. Dysphagia
200. Pyrosis
201. Cardiogmus

ORDER IV. ABDOMINALES INTERNI.

202. Cardialgia
203. Gastrodynia
204. Colica
205. Hepatalgia
206. Splenalgia
207. Nephralgia
208. Dystocia
209. Hysteralgia

ORDER V. EXTERNI ET ARTUUM.

210. Mastodynia
211. Rachialgia
212. Lumbago
213. Ischias
214. Proctalgia
215. Pudendagra

CLASS VIII. VESANIÆ.

ORDER I. HALLUCINATIONES.

216. Vertigo
217. Suffusio
218. Diplopia
219. Syrogmos
220. Hypochondriasis
221. Somnambulismus

ORDER II. MOROSITATES.

222. Pica
223. Bulimia
224. Polydipsia
225. Antipathia
226. Nostalgia
227. Panophobia
228. Satyriasis
229. Nymphomania
230. Tarantismus
231. Hydrophobia

ORDER III. DELIRIA.

232. Paraphrosyne
233. Amentia
234. Melancholia
235. Mania
236. Demonomania

ORDER IV. VESANIÆ ANOMALÆ.

237. Amnesia
238. Agrypnia

CLASS IX. FLUXUS.

ORDER I. SANGUIFLUXUS.

239. Hæmorrhagia
240. Hæmoptosis
241. Stomacace
242. Hæmatemesis
243. Hæmaturia
244. Menorrhagia
245. Abortus

ORDER II. ALVIFLUXUS.

246. Hepatirrhœa
247. Hæmorrhois
248. Dysenteria
249. Melæna
250. Nausea
251. Vomitus
252. Ileus
253. Cholera
254. Diarrhœa
255. Cœliaca
256. Lienteria
257. Tenesmus

ORDER III. SERIFLUXUS.

258. Ephidrosis
259. Epiphora
260. Coryza
261. Ptyalismus
262. Anacatharsis
263. Diabetes
264. Eneuresis
265. Dysuria
266. Pyuria
267. Leucorrhœa
268. Gonorrhœa
269. Dyspermatismus
270. Galactirrhœa
271. Octorrhœa

ORDER IV. ÆRIFLUXUS.

272. Flatulenta
273. Ædopsophia
274. Dysodia

CLASS X. CACHEXIÆ.

ORDER I. MACIES.

275. Tabes
276. Phthisis
277. Atrophia
278. Aridura

ORDER II. INTUMESCENTIÆ.

279. Polysarcia
280. Pneumatosis
281. Anasarca
282. Phlegmatia
283. Physconia
284. Graviditas

ORDER III. HYDROPES PARTIALES.

285. Hydrocephalus
286. Physocephalus
287. Hydrorachitis
288. Ascites
289. Hydrometra
290. Physometra
291. Tympanites
292. Metrorismus
293. Ischuria

ORDER IV. TUBERA.

294. Rachitis
295. Scrophula
296. Carcinoma
297. Leontiasis
298. Malis
299. Frambœsia

ORDER V. IMPETIGINES.

300. Syphilis
301. Scorbutus
302. Elephantiasis
303. Lepra
304. Scabies
305. Tinea

ORDER VI. ICTERITIÆ.

306. Aurigo	308. Phænigmus
307. Melanicterus	309. Chlorosis

ORDER VII. CACHEXIÆ ANOMALÆ.

310. Phthiriasis	313. Elcosis
311. Trichoma	314. Gangræna
312. Alopecia	315. Necrosis

Nosological Arrangement of LINNÆUS.

CLASS I. EXANTHEMATICI.

ORDER I. CONTAGIOSI.

1. Morbilli	4. Rubeola
2. Pestis	5. Petechia
3. Variola	6. Syphilis

ORDER II. SPORADICI.

7. Miliaria	9. Aphtha
8. Uredo	

ORDER III. SOLITARII.

10. Erysipelas

CLASS II. CRITICI.

ORDER I. CONTINENTES.

11. Diaria	13. Synochus
12. Synocha	14. Lenta

ORDER II. INTERMITTENTES.

15. Quotidiana	18. Duplicana
16. Tertiana	19. Errana
17. Quartana	

ORDER III. EXACERBANTES.

20. Amphimerina	23. Hemitritæa
21. Tritæus	24. Hectica
22. Tetartophia	

CLASS III. PHLOGISTICI.

ORDER I. MEMBRANACEI.

25. Phrenitis	29. Enteritis
26. Paraphrenesis	30. Proctitis.
27. Pleuritis	31. Cystitis
28. Gastritis	

ORDER II. PARENCHYMATICI.

32. Sphacelismus	36. Splenitis
33. Cynanche	37. Nephritis
34. Peripneumonia	38. Hysteritis
35. Hepatitis	

ORDER III. MUSCULOSI.

39 Phlegmone

CLASS IV. DOLOROSI.

ORDER I. INTRINSECI.

40. Cephalalgia	50. Colica
41. Hemicrania	51. Hepatica
42. Gravedo	52. Splenica
43. Ophthalmia	53. Pleuritica
44. Otalgia	54. Pneumonica
45. Odontalgia	55. Hysteralgia
46. Angina	56. Nephritica
47. Soda	57. Dysuria
48. Cardialgia	58. Pudendagra
49. Gastrica	59. Proctica

ORDER II. EXTRINSECI.

60. Arthritis	63. Volatica
61. Ostocopus	64. Pruritus
62. Rheumatismus	

CLASS V. MENTALES.

ORDER I. IDEALES.

65. Delirium	69. Dæmonia
66. Paraphrosyne	70. Vesania
67. Amentia	71. Melancholia
68. Mania	

ORDER II. IMAGINARII.

72. Syringmos	75. Panophobia
73. Phantasma	76. Hypochondriasis
74. Vertigo	77. Somnambulismus

ORDER III. PATHETICI.

78. Citta	84. Tarantismus
79. Bulimia	85. Rabies
80. Polydipsia	86. Hydrophobia
81. Satyriasis	87. Cacositia
82. Erotomania	88. Antipathia
83. Nostalgia	89. Anxietas

CLASS VI. QUIETALES.

ORDER I. DEFECTIVI.

90. Lassitudo	93. Lipothymia
91. Languor	94. Syncope
92. Asthenia	95. Asphyxia

ORDER II. SOPOROSI.

96. Somnolentia	101. Apoplexia
97. Typhomania	102. Paraplegia
98. Lethargus	103. Hemiplegia
99. Cataphora	104. Paralysis
100. Carus	105. Stupor

ORDER III. PRIVATIVI.

106. Morosis	108. Amblyopia
107. Oblivio	109. Cataracta

110. Amaurosis	116. Anorexia
111. Scotomia	117. Adipsia
112. Cophosis	118. Anaesthesia
113. Anosmia	119. Atecnia
114. Ageustia	120. Atonia
115. Aphonia	

CLASS VII. MOTORII.

ORDER I. SPASTICI.

121. Spasmus	126. Hysteria
122. Priapismus	127. Tetanus
123. Borborygmos	128. Catochus
124. Trismos	129. Catalepsis
125. Sardiasis	130. Agrypnia

ORDER II. AGITATORII.

131. Tremor	136. Stridor
132. Palpitatio	137. Hippos
133. Orgasmus	138. Psellismus
134. Subsultus	139. Chorea
135. Carpologia	140. Beriberi

ORDER II. AGITATORII.

141. Rigor.	144. Hieranosus
142. Convulsio	145. Raphania
143. Epilepsia	

CLASS VIII. SUPPRESSORII.

ORDER I. SUFFOCATORII.

146. Raucedo	155. Tussis
147. Vociferatio	156. Stertor
148. Risus	157. Anhelatio
149. Fletus	158. Suffocatio
150. Suspirium	159. Empyema
151. Oscitatio	160. Dyspnœa
152. Pandiculatio	161. Asthma
153. Singultus	162. Orthopnœa
154. Sternutatio	163. Ephialtes

ORDER II. CONSTRICTORII.

164. Aglutitio	168. Dysmenorrhœa
165. Flatulentia	169. Dyslochia
166. Obstipatio	170. Aglactatio
167. Ischuria	171. Sterilitas

CLASS IX. EVACUATORII.

ORDER I. CAPITIS.

172. Otorrhœa	175. Coryza
173. Epiphora	176. Stomacace
174. Hæmorrhagia	177. Ptyalismus

ORDER II. THORACIS.

178. Screatus	180. Hæmoptysis
179. Expectoratio	181. Vomica

ORDER III. ABDOMINIS.

182. Ructus	189. Lienteria
183. Nausea	190. Cœliaca
184. Vomitus	191. Cholirica
185. Hæmatemesis	192. Dysenteria
186. Iliaca	193. Hæmorrhois
187. Cholera	194. Tenesmus
188. Diarrhæa	195. Crepitus

ORDER IV. GENITALIUM.

196. Enuresis	199. Hæmaturia
197. Stranguria	200. Glus
198. Diabetes	201. Gonorrhœa

ORDER IV. GENITALIUM.

202. Leucorrhœa.	205. Abortus
203. Menorrhagia	206. Mola
204. Parturitio	

ORDER V. CORPORIS EXTERNI.

207. Galactia	208. Sudor

CLASS X. DEFORMES.

ORDER I. EMACIANTES.

209. Phthisis	212. Marasmus
210. Tabes	213. Rachitis
211. Atrophia	

ORDER II. TUMIDOSI.

214. Polysarcia	218. Ascites
215. Leucophlegmatia	219. Hyposarca
216. Anasarca	220. Tympanites
217. Hydrocephalus	221. Graviditas

ORDER III. DECOLORES.

222. Cachexia.	225. Icterus
223. Chlorosis	226. Plethora
224. Scorbutus.	

CLASS XI. VITIA.

ORDER I. HUMORALIA.

227. Aridura	232. Inflammatio
228. Digitium	233. Abscessus
229. Emphysema	234. Gangrena
230. Oedema	235. Sphacelus
231. Sugillatio	

ORDER II. DIALYTICA.

236. Fractura	243. Laceratura
237. Luxatura	244. Punctura
238. Ruptura	245. Morsura
239. Contusura	246. Combustura
240. Profusio	247. Excoriatura
241. Vulnus	248. Intertrigo
242. Amputatura	249. Rhagas.

ORDER VI. ICTERITIÆ.

306. Aurigo
307. Melasicterus
308. Phænigmus
309. Chlorosis

ORDER VII. CACHEXIÆ ANOMALÆ.

310. Phthiriasis
311. Trichoma
312. Alopecia
313. Eleosis
314. Gangræna
315. Necrosis

Nosological Arrangement of LINNÆUS.

CLASS I. EXANTHEMATICI.

ORDER I. CONTAGIOSI.

1. Morta
2. Pestis
3. Variola
4. Rubeola
5. Petechia
6. Syphilis

ORDER II. SPORADICI.

7. Miliaria
8. Uredo
9. Aphtha

ORDER III. SOLITARII.

10. Erysipelas

CLASS II. CRITICI.

ORDER I. CONTINENTES.

11. Diaria
12. Synocha
13. Synochus
14. Lenta

ORDER II. INTERMITTENTES.

15. Quotidiana
16. Tertiana
17. Quartana
18. Duplicana
19. Errana

ORDER III. EXACERBANTES.

20. Amphimerina
21. Tritæus
22. Tetartophia
23. Hemitritæa
24. Hectica

CLASS III. PHLOGISTICI.

ORDER I. MEMBRANACEI.

25. Phrenitis
26. Paraphrenesis
27. Pleuritis
28. Gastritis
29. Enteritis
30. Proctitis
31. Cystitis

ORDER II. PARENCHYMATICI.

32. Sphacelismus
33. Cynanche
34. Peripneumonia
35. Hepatitis
36. Splenitis
37. Nephritis
38. Hysteritis

ORDER III. MUSCULOSI.

39 Phlegmone

CLASS IV. DOLOROSI.

ORDER I. INTRINSECI.

40. Cephalalgia
41. Hermicrania
42. Gravedo
43. Ophthalmia
44. Otalgia
45. Odontalgia
46. Angina
47. Soda
48. Cardialgia
49. Gastrica
50. Colica
51. Hepatica
52. Splenica
53. Pleuritica
54. Pneumonica
55. Hysteralgia
56. Nephritica
57. Dysuria
58. Pudendagra
59. Proctica

ORDER II. EXTRINSECI.

60. Arthritis
61. Ostocopus
62. Rheumatismus
63. Volatica
64. Pruritus

CLASS V. MENTALES.

ORDER I. IDEALES.

65. Delirium
66. Paraphrosyne
67. Amentia
68. Mania
69. Dæmonia
70. Vesania
71. Melancholia

ORDER II. IMAGINARII.

72. Syringmos
73. Phantasma
74. Vertigo
75. Panophobia
76. Hypochondriasis
77. Somnambulismus

ORDER III. PATHETICI.

78. Citta
79. Bulimia
80. Polydipsia
81. Satyriasis
82. Erotomania
83. Nostalgia
84. Tarantismus
85. Rabies
86. Hydrophobia
87. Cacositia
88. Antipathia
89. Anxietas

CLASS VI. QUIETALES.

ORDER I. DEFECTIVI.

90. Lassitudo
91. Langour
92. Asthenia
93. Lipothymia
94. Syncope
95. Asphyxia

ORDER II. SOPOROSI.

96. Somnolentia
97. Typhomania
98. Lethargus
99. Cotaphora
100. Carus
101. Apoplexia
102. Paraplegia
103. Hemiplegia
104. Paralysis
105. Stupor

ORDER III. PRIVATIVI.

106. Morosis
107. Oblivio
108. Amblyopia
109. Cataracta

110. Amaurosis
111. Scotomia
112. Cophosis
113. Anosmia
114. Ageustia
115. Aphonia
116. Anorexia
117. Adipsia
118. Anæsthesia
119. Atecnia
120. Atonia

CLASS VII. MOTORII.

ORDER I. SPASTICI.

121. Spasmus
122. Priapismus
123. Borborygmos
124. Trismos
125. Sardiasis
126. Hysteria
127. Tetanus
128. Catochus
129. Catalepsis
130. Agrypnia

ORDER II. AGITATORII.

131. Tremor
132. Palpitatio
133. Orgasmus
134. Subsultus
135. Carpologia
136. Stridor
137. Hippos
138. Psellismus
139. Chorea
140. Beriberi

ORDER II. AGITATORII.

141. Rigor.
142. Convulsio
143. Epilepsia
144. Hieranosus
145. Raphania

CLASS VIII. SUPPRESSORII.

ORDER I. SUFFOCATORII.

146. Raucedo
147. Vociferatio
148. Risus
149. Fletus
150. Suspirium
151. Oscitatio
152. Pandiculatio
153. Singultus
154. Sternutatio
155. Tussis
156. Stertor
157. Anhelatio
158. Suffocatio
159. Empyema
160. Dyspnœa
161. Asthma
162. Orthopnœa
163. Ephialtes

ORDER II. CONSTRICTORII.

164. Aglutitio
165. Flatulentia
166. Obstipatio
167. Ischuria
168. Dysmenorrhœa
169. Dyslochia
170. Aglactatio
171. Sterilitas

CLASS IX. EVACUATORII.

ORDER I. CAPITIS.

172. Otorrhœa
173. Epiphora
174. Hæmorrhagia
175. Coryza
176. Stomacace
177. Ptyalismus

ORDER II. THORACIS.

178. Screatus
179. Expectoratio
180. Hæmoptysis
181. Vomica

ORDER III. ABDOMINIS.

182. Ructus
183. Nausea
184. Vomitus
185. Hæmatemesis
186. Iliaca
187. Cholera
188. Diarrhœa
189. Lienteria
190. Cœliaca
191. Cholirica
192. Dysenteria
193. Hæmorrhois
194. Tenesmus
195. Crepitus

ORDER IV. GENITALIUM.

196. Enuresis
197. Stranguria
198. Diabetes
199. Hæmaturia
200. Glus
201. Gonorrhœa

ORDER IV. GENITALIUM.

202. Leucorrhœa.
203. Menorrhagia
204. Parturitio
205. Abortus
206. Mola

ORDER V. CORPORIS EXTERNI.

207. Galactia
208. Sudor

CLASS X. DEFORMES.

ORDER I. EMACIANTES.

209. Phthisis
210. Tabes
211. Atrophia
212. Marasmus
213. Rachitis

ORDER II. TUMIDOSI.

214. Polysarcia
215. Leucophlegmatia
216. Anasarca
217. Hydrocephalus
218. Ascites
219. Hyposarca
220. Tympanites
221. Graviditas

ORDER III. DECOLORES.

222. Cachexia.
223. Chlorosis
224. Scorbutus.
225. Icterus
226. Plethora

CLASS XI. VITIA.

ORDER I. HUMORALIA.

227. Aridura
228. Digitium
229. Emphysema
230. Oedema
231. Sugillatio
232. Inflammatio
233. Abscessus
234. Gangrena
235. Sphacelus

ORDER II. DIALYTICA.

236. Fractura
237. Luxatura
238. Ruptura
239. Contusura
240. Profusio
241. Vulnus
242. Amputatura
243. Laceratura
244. Punctura
245. Morsura
246. Combustura
247. Excoriatura
248. Intertrigo
249. Rhagas.

ORDER III. EXULCERATIONES.

250. Ulcus.
251. Cacoethes
252. Noma
253. Carcinoma
254. Ozena
255. Fistula
256. Caries
257. Arthrocace
258. Cocyta
259. Paronychia
260. Pernio
261. Pressura
262. Arctura

ORDER IV. SCABIES.

263. Lepra
264. Tinea
265. Achor
266. Psora
267. Lippitudo
268. Serpigo
269. Herpes
270. Varus
271. Bacchia
272. Bubo
273. Anthrax
274. Phlyctæna
275. Pustula
276. Papula
277. Hordeolum
278. Verruca
279. Clavus
280. Myrmecium
281. Eschara

ORDER V. TUMORES PROTUBERANTES.

282. Aneurisma
283. Varix
284. Schirrus
285. Struma
286. Atheroma
287. Anchylosus
288. Ganglion
289. Natta
290. Spinola
291. Exostosis

ORDER VI. PROCIDENTIÆ.

292. Hernia
293. Prolapsus
294. Condyloma
295. Sarcoma
296. Pterygium
297. Ectropium
298. Phimosis
299. Clitorismus

ORDER VII. DEFORMATIONES.

300. Contractura
301. Gibber
302. Lordosis
303. Distortio
304. Tortura
305. Strabismus
306. Lagophthalmia
307. Nyctalopia
308. Presbytia
309. Myopia
310. Labarium
311. Lagostoma
312. Apella
313. Atreta
314. Plica
315. Hirsuties
316. Alopecia
317. Trichiasis

ORDER VIII. MACULÆ.

318. Cicatrix
319. Nævus
320. Morphæa
321. Vibex
322. Sudamen
323. Melasma
324. Hepatizon
325. Lentigo
326. Ephelis

Nosological Arrangement of VOGEL.

CLASS I. FEBRES.

ORDER I. INTERMITTENTES.

1. Quotidiana
2. Ternatia
3. Quartana
4. Quintana
5. Sextana
6. Septana
7. Octana
8. Nonana
9. Decimana
10. Vaga
11. Menstrua
12. Tertiana duplex
13. Quartana duplex
14. Quartana triplex

ORDER II. CONTINUÆ.

§ 1. *Simplices.*

15. Quotidiana
16. Synochus
17. Amatoria
18. Phrenitis
19. Epiala
20. Causos
21. Elodes
22. Lethargus
23. Typhomania
24. Leipyria
25. Phricodes
26. Lyngodes
27. Asodes
28. Cholerica
29. Synchopalis
30. Hydrophobia
31. Oscitans
32. Ictericodes
33. Pestilentialis
34. Siriasis

§ 2. *Compositæ.*

¶ 1. *Exanthematica.*

35. Variolosa
36. Morbillosa
37. Miliaris
38. Petechialis
39. Scarlatina
40. Urtica
41. Bullosa
42. Varicella
43. Pemphingodes
44. Aphthosa

¶ 2. *Inflammatoria.*

45. Phrenismus
46. Chemosis
47. Ophthalmites
48. Otites
49. Angina
50. Pleuritis
51. Peripneumonia
52. Mediastina
53. Pericarditis
54. Carditis
55. Paraphrenitis
56. Gastritis
57. Enteritis
58. Hepatitis
59. Splenitis
60. Mesenteritis
61. Omentitis
62. Peritonitis
63. Myocolitis
64. Pancreatica
65. Nephritis
66. Cistitis
67. Hysteritis
68. Erysipelacea
69. Podagrica
70. Panaritia
71. Cyssotis

¶ 3. *Symptomatica.*

72. Apoplectica
73. Catarrhalis
74. Rheumatica
75. Hæmorrhoidalis
76. Lactea
77. Vulneraria
78. Suppuratoria
79. Lenta
80. Hectica

CLASS II. PROFLUVIA.

ORDER I. HÆMORRHAGIÆ.

81. Hæmorrhagia
82. Epistaxis
83. Hæmoptoe
84. Hæmoptysis
85. Stomacace
86. Odontirrhœa
87. Otorrhœa
88. Ophthalmorrhagia
89. Hæmatemesis
90. Heptirrhœa
91. Catarrhexis
92. Hæmaturia
93. Cystirrhagia
94. Stymatosis
95. Hæmatopedesis
96. Menorrhagia
97. Abortio

ORDER II. APOCENOSES.

98. Catarrhus
99. Epiphora
100. Coryza
101. Otopuosis

102. Otoplatos
103. Ptyalismus
104. Vomica
105. Diarrhœa
106. Puorrhœa
107. Dysenteria
108. Lienteria
109. Cœliaca
110. Cholera
111. Pituitaria
112. Leucorrhois
113. Eneuresis
114. Diuresis
115. Diabetes
116. Puoturia
117. Chylaria
118. Gonorrhœa
119. Leucorrhœa
120. Exoneirosis
121. Hydropedesis
122. Galactia
123. Hypercatharsis
124. Ecphyse
125. Dysodia

CLASS III. EPISCHESES.

126. Gravedo
127. Flatulentia
128. Obstipatio
129. Ischuria
130. Amenorrhœa
131. Dyslochia
132. Deuteria
133. Agalaxis

CLASS IV. DOLORES.

134. Anxietas
135. Blestrismus
136. Pruritus
137. Catapsyxis
138. Rheumatismus
139. Arthritis
140. Cephalalgia
141. Cephalæa
142. Clavus
143. Hemicrania
144. Carebaria
145. Odontalgia
146. Hæmodia
147. Odaxismus
148. Otalgia
149. Acataposis
150. Cionis
151. Himantosis
152. Cardiogmus
153. Mastodynia
154. Soda
155. Periadynia
156. Pneumatosis
157. Cardiaglia
158. Encausis
159. Nausea
160. Colica
161. Eilema
162. Ileus
163. Stranguria
164. Dysuria
165. Lithuriasis
166. Tenesmus
167. Clunesia
168. Cedma
169. Hysteralgia
170. Dysmenorrhœa
171. Dystochia
172. Atocia
173. Priapismus
174. Psoriasis
175. Podagra
176. Osteocopus
177. Psophos
178. Volatica
179. Epiphlogisma

CLASS V. SPASMI.

180. Tetanus
181. Opisthotonus
182. Episthotonus
183. Catochus
184. Tremor
185. Frigus
186. Horror
187. Rigor
188. Epilepsia
189. Heclampsia
190. Hieranosus
191. Convulsio
192. Raphania
193. Chorea
194. Crampus
195. Scelotyrbe
196. Angone
197. Glossocele
198. Glossocoma
199. Hippos
200. Illosis
201. Cinclesis
202. Cataclasis
203. Cillosis
204. Sternutatio
205. Tussis
206. Clamor
207. Trismus
208. Capistrum
209. Sardiasis
210. Gelasmus
211. Incubus
212. Singultus
213. Palpitatio
214. Vomitus
215. Ructus
216. Ruminatio
217. Oesophagismus
218. Hypochondriasis
219. Hysteria
220. Phlogosis
221. Digitium

CLASS VI. ADYNAMIÆ.

222. Lassitndo
223. Asthenia
224. Torpor
225. Adynamia
226. Paralysis
227. Paraplegia
228. Hemiplegia
229. Apoplexia
230. Catalepsis
231. Carus
232. Coma
233. Somnolentia
234. Hypophasis
235. Ptosis
236. Amblyopia
237. Mydriasis
238. Amaurosis
239. Cataracta
240. Synizezis
241. Glaucoma
242. Achlys
243. Nyctalopia
244. Hermeralopia
245. Hemalopia
246. Dysicoia
247. Surditas
248. Anosmia
249. Apogeusis
250. Asaphia
251. Clangor
252. Raucitas
253. Aphonia
254. Leptophonia
255. Oxyphonia
256. Rhenophonia
257. Mutitas
258. Traulotis
259. Psellotis
260. Ischnophonia
261. Battarismus
262. Suspirium
263. Oscitatio
264. Pandiculatio
265. Apnœa
266. Macropnœa
267. Dyspnœa
268. Asthma
269. Orthopnœa
270. Pnigma
271. Renchus
272. Rhochmos
273. Lipothymia
274. Syncope
275. Asphyxia
276. Apepsia
277. Dyspepsia
278. Diaphthora
279. Anorexia
280. Anatrope
281. Adypsia
282. Acyisis
283. Agenesia
284. Anodynia

CLASS VII. HYPÆRESTHESES.

285. Antipathia
286. Agrypnia
287. Phantasma
288. Caligo
289. Hæmalopia
290. Marmaryge
291. Dysopia
292. Susurrus
293. Vertigo
294. Apogeusia
295. Polydipsia
296. Bulimus
297. Addephagia
298. Cynorexia
299. Allotriophagia
300. Malacia
301. Pica
302. Bombus
303. Celsa

CLASS VIII. CACHEXIÆ.

304. Cachexia
305. Chlorosis
306. Icterus
307. Melanchlorus

308. Atrophia
309. Tabes
310. Phthisis
311. Hydrothorax
312. Rachitis
313. Anasarca
314. Ascites
315. Hydrocystis
316. Tympanites
317. Hysterophyse
318. Scorbutus
319. Syphilis
320. Lepra
321. Elephantiasis
322. Elephantia
323. Plica
324. Phthiriasis
325. Physconia
326. Paracyisis
327. Gangræna
328. Sphacelus

CLASS IX. PARANOIÆ.

329. Athymia
330. Delirium
331. Mania
332. Melancholia
333. Ecstasis
334. Ecplexis
335. Enthusiasmus
336. Stupiditas
337. Amentia
338. Oblivio
339. Somnium
340. Hypnobatasis

CLASS X. VITIA.

ORDER I. INFLAMMATIONES.

341. Ophthalmia
342. Blepharotis
343. Erysipelas
344. Hieropyr
345. Paronychia
346. Onychia
347. Encausis
348. Phimosis
349. Paraphimosis
350. Pernio

ORDER II. TUMORES.

351. Phlegmone
352. Furunculus
353. Anthrax
354. Abscessus
355. Onyx
356. Hippopyon
357. Phygethlon
358. Empyema
359. Phyma
360. Ecthymata
361. Urticaria
362. Parulis
363. Epulis
364. Anchylops
365. Paraglossa
366. Chilon
367. Scrophula
368. Bubon
369. Bronchocele
370. Parotis
371. Gongrona
372. Sparganosis
373. Coilima
374. Scirrhus
375. Cancer
376. Sarcoma
377. Polypus
378. Condyloma
379. Ganglion
380. Ranula
381. Terminthus
382. Oedema
383. Encephalocele
384. Hydrocephalum
385. Hydrophthalmia
386. Spina bifida
387. Hydromphalus
388. Hydrocele
389. Hydrops Scroti
390. Steatites
391. Pneumatosis
392. Emphysema
393. Hysteroptosis
394. Cystoptosis
395. Archoptoma
396. Bubonocele
397. Oscheocele
398. Omphalocele
399. Merocele
400. Enterocele ovularis
401. Ischiatocele
402. Elytrocele
403. Hypogastrocele
404. Cystocele
405. Cyrtoma
406. Hydrenterocele
407. Varix
408. Aneurisma
409. Cirsocele
410. Gastrocele
411. Hepatocele
412. Splenocele
413. Hysterocele
414. Hygrocirsocele
415. Sarcocele
416. Physcocele
417. Exostoses
418. Hyperostosis
419. Pædarthrocace
420. Encystis
421. Staphyloma
422. Staphylosis
423. Fungus
424. Tofus
425. Flemen

ORDER III. EXTUBERANTIÆ.

426. Verruca
427. Porrus
428. Clavus
429. Callus
430. Encanthis
431. Pladarotis
432. Pinnula
433. Pterygium
434. Hordeolum
435. Grando
436. Varus
437. Gutta rosacea
438. Ephelis
439. Esoche
440. Exoche

ORDER IV. PUSTULÆ AND PAPULÆ.

441. Epinyctis
442. Phlyctæna
443. Herpes
444. Scabies
445. Aquula
446. Hydroa
447. Variola
448. Varicella
449. Purpura
450. Encauma

ORDER V. MACULÆ.

451. Ecchymoma
452. Petechiæ
453. Morbilli
454. Scarlatæ
455. Lentigo
456. Urticaria
457. Stigma
458. Vibex
459. Vitiligo
460. Leuce
461. Cyasma
462. Lichen
463. Selina
464. Nebula

ORDER VI. DISSOLUTIONES.

465. Vulnus
466. Ruptura
467. Rhagas
468. Fractura
469. Fissura
470. Plicatio
471. Thlasis
472. Luxatio
473. Subluxatio
474. Diachalasis
475. Attritis
476. Porrigo
477. Aposyrma
478. Anapleusis
479. Spasma
480. Contusio
481. Diabrosis
482. Agomphiasis
483. Eschara
484. Piptonychia
485. Cacoethes
486. Therioma
487. Carcinoma
488. Phagedæna
489. Noma
490. Sycosis
491. Fistula
492. Sinus
493. Caries
494. Achores
495. Crusta lactea
496. Favus
497. Tinea
498. Argemon
499. Ægilops
500. Ozæna

501. Aphthæ
502. Intertrigo
503. Rhacosis

ORDER VII. CONCRETIONES.

504. Ancyloblepharon
505. Zynizesis
506. Dacrymoma
507. Ancyloglossum
508. Ancylosis
509. Cicatrix
510. Dactylion

CLASS XI. DEFORMITATES.

511. Phoxos
512. Gibbus
513. Caput obstipum
514. Strabismus
515. Myopiasis
516. Lagophthalmus
517. Trichiasis
518. Ectropium
519. Entropium
520. Rhœas
521. Rhyssemata
522. Lagocheilos
523. Melachosteon
524. Hirsuties
525. Canities
526. Distrix
527. Xirasia
528. Phalacrotis
529. Alopecia
530. Madarosis
531. Ptilosis
532. Rodatio
533. Phalangosis
534. Coloboma
535. Cercosis
536. Cholosis
537. Gryposis
538. Nævus
539. Monstrositas
540. Polysarcia
541. Ischnotis
542. Rhicnosis
543. Varus
544. Valgus
545. Leiopodes
546. Apella
547. Hypospadiæos
548. Urorhœas
549. Atreta
550. Saniodes
551. Cripsorchis
552. Hermaphrodites
553. Dionysiscus
554. Artetiscus
555. Nefrendis
556. Spanopogon
557. Hyperartetiscus
558. Galiancon
559. Galbulus
560. Mola

Nosological Arrangement of SAGAR.

CLASS I. VITIA.

ORDER I. MACULÆ.

1. Leucoma
2. Vitiligo
3. Ephelis
4. Nævus
5. Ecchymoma

ORDER II. EFFLORESCENTIA.

6. Pustula
7. Papula
8. Phlyctæna
9. Bacchia
10. Varus
11. Herpes
12. Epinyctis
13. Hemeropathos
14. Psydracia
15. Hydroa

ORDER III. PHYMATA.

16. Erythema
17. Oedema
18. Emphysema
19. Scirrhus
20. Inflammatio
21. Bubo
22. Parotis
23. Furunculus
24. Anthrax
25. Cancer
26. Paronychia
27. Phimosis

ORDER IV. EXCRESCENTIÆ.

28. Sarcoma
29. Condyloma
30. Verruca
31. Pterygium
32. Hordeolum
33. Trachelophyma
34. Exostosis

ORDER V. CYSTIDES.

35. Aneurysma
36. Varix
37. Marisca
38. Hydatis
39. Staphyloma
40. Lupia
41. Hydarthrus
42. Apostema
43. Exomphalus
44. Oscheophyma

ORDER VI. ECTOPIÆ.

45. Exophthalmia
46. Blepharoptosis
47. Hypostaphyle
48. Paraglossa
49. Proptoma
50. Exania
51. Exocystis
52. Hysteroptosis
53. Colpoptosis
54. Gastrocele
55. Omphalocele
56. Hepatocele
57. Merocele
58. Bubonocele
59. Opodeocele
60. Ischiocele
61. Colpocele
62. Perinæocele
63. Peritonæorixis
64. Encephalocele
65. Hysteroloxia
66. Parorchydium
67. Exarthrema
68. Diastasis
69. Loxarthrus
70. Gibbositas
71. Lordosis

ORDER VII. DEFORMITATES.

72. Lagostoma
73. Apella
74. Polymerisma
75. Epidosis
76. Anchylomerisma
77. Hirsuties

CLASS II. PLAGÆ.

ORDER I. SOLUTIONES.

Recentes, Cruentæ.

78. Vulnus
79. Punctura
80. Sclopetoplaga
81. Morsus
82. Excoriatio
83. Contusio
84. Ruptura

ORDER II. SOLUTIONES.

Recentes, Cruentæ, Artificiales.

85. Operatio
86. Amputatio
87. Sutura
88. Paracentesis

ORDER III. SOLUTIONES.

Incruentæ.

89. Ulcus
90. Exulceratio
91. Fistula
92. Sinus
93. Eschara
94. Caries
95. Arthrocace

ORDER IV. SOLUTIONES.

Anomalæ.

96. Rhagas
97. Ambustio
98. Fractura
99. Fissura

CLASS III. CACHEXIÆ.

ORDER I. MACIES.

100. Tabes
101. Phthisis
102. Atrophia
103. Hæmatoporia
104. Aridura

ORDER II. INTUMESCENTIÆ.

105. Plethora
106. Polysarcia
107. Pneumatosis
108. Anasarca
109. Phlegmatia
110. Physconia
111. Graviditas

ORDER III. HYDROPES.

Partiales.

112. Hydrocephalus
113. Physocephalus
114. Hydrorachitis
115. Ascites
116. Hydrometra
117. Physometra
118. Tympanites
119. Meteorismus

ORDER IV. TUBERA.

120. Rachitis
121. Scrophula
122. Carcinoma
123. Leontiasis
124. Malis
125. Frambœsia

ORDER V. IMPETIGINES.

126. Syphilis
127. Scorbutus
128. Elephantiasis
129. Lepra
130. Scabies
131. Tinea

ORDER VI. ICTERITIÆ.

132. Aurigo
133. Melasicterus
134. Phœnigmus
135. Chlorosis

ORDER VII. ANOMALÆ.

136. Phthiriasis
137. Trichoma
138. Alopecia
139. Elcosis
140. Gangræna
141. Necrosis

CLASS IV. DOLORES.

ORDER I. VAGI.

142. Arthritis
143. Ostocopus
144. Rheumatismus
145. Catarrhus
146. Anxietas
147. Lassitudo
148. Stupor
149. Pruritus
150. Algor
151. Ardor

ORDER II. CAPITIS.

152. Cephalalgia
153. Cephalæa
154. Hemicrania
155. Ophthalmia
156. Otalgia
157. Odontalgia

ORDER III. PECTORIS.

158. Pyrosis
159. Cardiogmus

ORDER IV. ABDOMINIS.

160. Cardialgia
161. Gastrodynia
162. Colica
163. Hepatalgia
164. Splenalgia
165. Nephralgia
166. Hysteralgia

ORDER V. EXTERNARUM.

167. Mastodynia
168. Rachialgia
169. Lumbago
170. Ischias
171. Proctalgia
172. Pudendagra
173. Digitium

CLASS V. FLUXUS.

ORDER I. SANGUIFLUXUS.

174. Hæmorrhagia
175. Hæmoptysis
176. Stomacace
177. Hæmatemesis
178. Hæmaturia
179. Metrorrhagia
180. Abortus

ORDER II. ALVIFLUXUS.

Sanguinolenti.

181. Hepatirrhœa
182. Hæmorrhois
183. Dysenteria
184. Melæna

ORDER III. ALVIFLUXUS.

Non Sanguinolenti.

185. Nausea
186. Vomitus
187. Ileus
188. Cholera
189. Diarrhœa
190. Cœliaca
191. Lienteria
192. Tenesmus
193. Proctorrhœa

ORDER IV. SERIFLUXUS.

194. Ephidrosis
195. Epiphora
196. Coryza
197. Ptyalismus
198. Anacatharsis
199. Diabetes
200. Enuresis
201. Pyuria
202. Leucorrhœa
203. Lochiorrhœa
204. Gonorrhœa
205. Galactirrhœa
206. Otorrhœa

ORDER V. ÆRIFLUXUS.

207. Flatulentia
208. Ædopsophia
209. Dysodia

CLASS VI. SUPPRESSIONES.

ORDER I. EGERENDORUM.

210. Adiapneustia
211. Sterilitas
212. Ischuria
213. Dysuria
214. Aglactatio
215. Dyslochia

ORDER II. INGERENDORUM.

216. Dysphagia
217. Angina

ORDER III. IMI VENTRIS.

218. Dysmenorrhœa
219. Dystocia
220. Dyshæmorrhois
221. Obstipatio

CLASS VII. SPAPMI.

ORDER I. TONICI PARTIALES.

222. Strabismus
223. Trismus
224. Obstipitas
225. Contractura
226. Crampus
227. Priapismus

ORDER II. TONICI GENERALES.

228. Tetanus
229. Catochus

ORDER III. CLONICI PARTIALES.

230. Nystagmus
231. Carphologia
232. Subsultus
233. Pandiculatio
234. Apomystosis
235. Convulsio
236. Tremor
237. Palpitatio
238. Claudicatio

ORDER IV. CLONICI GENERALES.

239. Phricasmus
240. Eclampsia
241. Epilepsia
242. Hysteria
243. Scelotyrbe
244. Beriberia

CLASS VIII. ANHELATIONES.

ORDER I. SPASMODICÆ.

245. Ephialtes
246. Sternutatio
247. Oscedo
248. Singultus
249. Tussis.

ORDER II. SUPPRESSIVÆ.

250. Stertor
251. Dyspnœa
252. Asthma
253. Orthopnœa
254. Pleurodyne
255. Rheuma
256. Hydrothorax
257. Empyema

CLASS IX. DEBILITATES.

ORDER I. DYSÆSTHESIÆ.

258. Amblyopia
259. Caligo
260. Cataracta
261. Amaurosis
262. Anosmia
263. Agheustia
264. Dysecœa
265. Paracusis
266. Cophosis
267. Anæsthesia

ORDER II. ANEPITHYMIÆ.

268. Anorexia
269. Adipsia
270. Anaphrodisia

ORDER III. DYSCINESIÆ.

271. Mutitas
272. Aphonia
273. Psellismus
274. Cacophonia
275. Paralysis
276. Hemiplegia
277. Paraplexia

ORDER IV. LEIPOPSYCHIÆ.

278. Asthenia
279. Lipothymia
280. Syncope
281. Asphyxia

ORDER V. COMATA.

282. Catalepsis
283. Ecstasis
284. Typhomania
285. Lethargus
286. Cataphora
287. Carus
288. Apoplexia

CLASS X. EXANTHEMATA.

ORDER I. CONTAGIOSA.

289. Pestis
290. Variola
291. Pemphigus
292. Purpura
293. Rubeola
294. Scarlatina

ORDER II. NON CONTAGIOSA.

295. Miliaris
296. Erysipelas
297. Essera
298. Aphtha

CLASS XI. PHLEGMASIÆ.

ORDER I. MUSCULOSÆ.

299. Phlegmone
300. Cynanche
301. Myositis
302. Carditis

ORDER II. MEMBRANACEÆ.

303. Phrenitis
304. Diaphragmitis
305. Pleuritis
306. Gastritis
307. Enteritis
308. Epiploitis
309. Cystitis

ORDER III. PARENCHYMATOSÆ.

310. Cephalitis
311. Peripneumonia
312. Hepatitis
313. Splenitis
314. Nephritis
315. Metritis

CLASS XII. FEBRES.

ORDER I. CONTINUÆ.

316. Judicatoria
317. Humoraria
318. Frigeraria
319. Typhus
320. Hectica

ORDER II. REMITTENTES.

321. Amphimerina
322. Tritæophya
323. Tetartophya

ORDER III. INTERMITTENTES.

324. Quotidiana
325. Tertiana
326. Quartana
327. Erratica

CLASS XIII. VESANIÆ.

ORDER I. HALLUCINATIONES.

328. Vertigo
329. Suffusio
330. Diplopia
331. Syrigmos
332. Hypochondriasis
333. Somnambulismus

ORDER II. MOROSITATES.

334. Pica	340. Satyriasis
335. Bulimia	341. Nymphomania
336. Polydipsia	342. Tarantismus
337. Antipathia	343. Hydrophobia
338. Nostalgia	344. Rabies
339. Panophobia	

ORDER III. DELIRIA.

345. Paraphrosine	348. Dæmonomania
346. Amentia	349. Mania
347. Melancholia	

ORDER IV. ANOMALÆ.

350. Amnesia	351. Agrypnia.

Our remarks upon these different arrangements must be cursory. That of Vogel's would appear at first sight to be the fullest, as comprising not less than five hundred and sixty distinct genera of diseases; and that of Cullen's the least complete, as extending to not more than a hundred and fifty; but when it is reflected upon, that nearly five parts out of six of the distinct genera of Vogel are regarded as mere species of other genera by Cullen, and arranged accordingly; the latter must at once be allowed to be equally full, and to possess a high advantage in point of simplicity. Sagar's is the most numerous next to Vogel's; and like Vogel's it is numerous, not from the possession of additional matter, but from extending to distinct genera, diseases of the same genus, and which ought to rank merely as separate species, or even varieties. In the general arrangement of these nosologists, we perceive a considerable resemblance to that of Sauvage: their classes, though differently disposed, are nearly alike as well in name as in number; yet Sauvage's is the most simple, at the same time that it is the most comprehensive. The arrangement of Linnæus is like all his arrangements, neat and classical, perhaps the most classical of the whole of those now before us. His system is in a great measure his own: he has however more classes, and genera, but fewer orders than Sauvage; and it is not always that the terms of his classes are sufficiently characteristic of the diseases that rank under them. Many of those that are disposed under the class quietales, for example, are as much diseases of the mind, as several that are placed immediately under the class mentales; and we are afraid that the term dolorosi peculiarly applied to Class IV. is just as applicable to a great multitude of diseases distributed under other classes, as it is to the tribe which is thus connectively arranged.

Of Dr. Cullen's table it is obvious that its chief features are due to himself alone—his classes are for the most part simple, and at the same time comprehensive, his orders are natural, and his genera ably disposed. The most objectionable of his classes is the last, or that entitled locales, which, like the cryptogamia of Linnæus's botanical system, is a mere appendix for the purpose of comprehending whatever could not conveniently be disposed under the previous heads. There is also some confusion as to a few of his orders, and we may here enumerate profluvia in Class I. compared with apocenoses in Class IV. since the former is only a Latin, and the latter a Greek word of the same meaning; and since the diseases in the former order are only distinct genera of the latter in many instances; there is also some doubt as to the situation of several of his genera. Nevertheless, it is upon the whole, the best division that has hitherto appeared; it is far more generally studied and lectured from than any other; and under this division therefore we shall proceed to notice cursorily the different genera according to this classification, and to describe the character and mode of cure of the more common or more prominent.

PRAXIS.

This is the last division comprised under this article; and, from the explanation we have just given of it, it is obvious that it is the most important.

CLASS I.

PYREXIÆ.

Frequent pulse, succeeded by shivering or horror; increased heat; disturbed functions; prostration of strength.

ORDER I. *Febris.* FEVER.

Pyrexy independent of local affection as its cause; languor, lassitude, and other signs of debility.

This order is divided into two sections, an intermittent, including tertians, quartans, and quotidians, with the different varieties of these distinct genera; and continued, which include the genera of synocha, or simple inflammatory fever; typhus, putrid, or jail-fever; and synochus, a mixed fever commencing like the first and terminating like the second. The intermittent family are defined as follows: Fevers arising from the miasm of marshy grounds with an evident remission, the returning

fits being almost always ushered in by horror or trembling. One paroxysm only in the day. The continued family are defined thus: fevers without intermission, not occasioned by marsh miasm, attended with exacerbations and remissions, though not very perceptible.

The remote causes of fever are not always to be easily or accurately distinguished, and of the proximate causes we may fairly be said to know nothing, since so many different conjectures, often in direct hostility to each other have been offered, by writers of the first reputation, and the system of yesterday has so frequently fallen before that of to day. Without entering therefore into this controverted subject, we shall proceed to an account of the general symptoms and mode of treatment.

Intermittents.—Symptoms. A regular paroxysm of this fever is divided into three stages—the cold, hot, and sweating stage.

The first stage commences with yawning and stretching; there is at the same time an uneasy sense of weariness or inaptitude to motion, accompanied with some degree of debility; paleness and shrinking of the features and extremities are also observable; at this period some coldness of the extremities may be felt by another person, although the patient takes little or no notice of it; the skin, however, becomes rough, as is the case in cold weather, and is less sensible than usual; a sensation of coldness is now felt by the patient himself, which is at first referred to the back, and gradually spreads over the whole body, producing an universal shaking: after this has lasted for some time, the patient's sensation of cold still continuing, the warmth of his skin, to the feeling of another person, or measured by the thermometer, gradually increases; there is nausea, and frequently vomiting of a bilious matter; pains of the back, limbs, loins, and head-ach, or more commonly drowsiness, stupor, or a considerable degree of coma attend this stage; the respiration is frequent and anxious; the pulse is small, frequent, sometimes irregular, and often scarcely perceptible; the urine is almost colourless, and without cloud or sediment.

As the cold and shivering, after alternating for some time with warm flushings, gradually abate, the hot stage is ushered in by a preternatural heat, the pulse becomes full, strong, and hard, the respiration is more free, but still frequent and anxious, the paleness and shrinking of the features, together with the constriction of the skin, now disappear, and are succeeded by a general redness and turgescence; the tongue is white and dry, the thirst is considerable, the skin continues parched, the head-ach, if it was absent in the first stage, now comes on, is accompanied with throbbing of the temporal arteries, and frequently rises to delirium, and the urine is high coloured; as the hot stage advances, the nausea and vomiting abate, and on the appearance of moisture upon the skin, they generally cease altogether. The hot stage is at length terminated by a profuse sweat, which breaks out, first about the face and breast; it gradually extends over the whole body, and terminates the paroxysm; most of the functions are restored to their natural state, the respiration becomes free, the urine deposits a lateritious sediment, the sweat gradually ceases, and with it the febrile symptoms; the patient is, however, left in a weak and wearied state: between the paroxysms, the patient is more easily fatigued than usual, complains of want of appetite, and the skin is parched, or he is more liable to profuse perspiration than in health. The cold fit of this species is longer than that of the quotidian, but shorter than that of the quartan, and the whole paroxysm is shorter than that of the quotidian, but longer than that of the quartan.

The predisposing causes of intermittents are, whatever tends to debilitate the body, a warm moist, or cold damp atmosphere, particular seasons, as spring and autumn: the occasional or exciting causes are, marsh miasm, contagion, and perhaps lunar influence.

Prognosis. Mildness and regularity of the paroxysm, a general cutaneous eruption, or an eruption about the mouth and behind the ears, accompanied with a swelling of the upper lip, when the paroxysm is going off; a free hemorrhage from the nose during the paroxysm, and the urine depositing a lateritious sediment in the last stage, are favourable symptoms. Coma, delirium, great anxiety, difficult respiration, attended with hiccup, swelling of the tonsils, the abdomen tumid, hard, and painful to the touch, accompanied with obstinate costiveness, tension and pain in the epigastric and hypochondric regions during the paroxysm; listlessness, nausea, or debility, attended with vertigo in the intermissions, or a few drops of blood falling from the nose in the paroxysm, are unfavourable symptoms. Intermittents are frequently followed by, or attended with, ob-

structions in the different viscera, particularly in the liver and spleen; dropsy, dysentery, jaundice, and various species of inflammation.

Treatment. In the paroxysms we are to endeavour to shorten the different stages, and thus to obtain a final solution of the disease. In the intermissions we are to prevent the recurrence of the paroxysms, and endeavour to obviate certain circumstances, which may prevent the fulfilling of either of the two first indications.

The first indication will be accomplished by the administration of an emetic at the commencement of the paroxysm, or during the cold stage; for which purpose tartar emetic is the best; it should be given in divided, but pretty large doses, the patient should at the same time be put to bed, kept in warm blankets, and allowed warm diluent, but not stimulating liquors, except there is a considerable degree of debility; and immediately the hot stage is formed, a gentle diaphoresis will be excited, and a final solution of the paroxysm procured, by the exhibition of opiates, assisted by moderate draughts of tepid, or, if the heat be preternaturally great, of cold liquids, and by the neutral salts. In the intermissions, the bark should be administered in doses of a drachm or more, every one, two, or three hours, so that an ounce, or an ounce and a half may be taken during the intermission; when the apyrexy is long, as in the tertian, its exhibition may be delayed till within six or eight hours of the time when the next paroxysm is expected, which will frequently more effectually prevent its return than when given in small doses during a long intermission; but if there be a great degree of debility, or where the intermissions are short, as in the quotidian, the bark should be employed immediately after the termination of the paroxysm, at longer or shorter intervals, until the return of the next fit, in such doses as the stomach will bear, and the urgency of the case may require: when this invaluable medicine purges, a few drops of the tincture of opium may be added; and if on the other hand, it induce costiveness, a few grains of rhubarb will obviate it, and at the same time give tone to the stomach and bowels; it is sometimes of service to add about a scruple of snake-root to each dose of the bark; where the stomach is habitually weak, it will be advisable to combine aromatics or bitters with the bark, as calamus, or canella alba, &c. The sulphate of copper may be employed in its usual dose: the oxide of arsenic combined with opiates, either in solution or in the form of pills, will frequently succeed, when bark and other remedies have been tried without effect. If the disease should prove obstinate, and any pain can be perceived by the patient upon pressing the right hypochondrium, small doses of the calomel, or friction with the unguentum hydrargyri, continued until a slight soreness of the mouth is induced, will, in general, be attended with the most beneficial effects, as its continuance is most commonly the consequence of obstructed viscera.

The circumstances which prevent our fulfilling the two first indications are, inflammatory diathesis, accumulation of bile in the stomach, and of that and fæces in the intestinal canal. The first circumstance will be removed by blood-letting; and if, during the paroxysm, any urgent symptoms indicate the presence of that diathesis, it will be attended with the greatest prospect of success, if the operation is performed during the hot stage, when the excitement is most considerable: the latter causes will be removed by the administration of emetics and cathartics: if there be a great degree of debility, the system must be strengthened by a generous diet, the moderate use of wine, gentle exercise, the cold bath, and change of air. As in this disease relapses very frequently occur, it will not only be advisable, but necessary, to continue the use of the bark in doses of a drachm four times a day, for two or three weeks, at the same time the patient must most studiously avoid all the exciting causes, and every irregularity in diet. Vernal are less liable than autumnal intermittents, to become continued fevers, and are rarely attended with alarming symptoms, or followed by dangerous obstructions. The taste of the bark will be concealed in a great measure, by exhibiting it in milk, butter-milk, or infusion of liquorice; and if the stomach should possess a considerable degree of irritability, opium administered either by itself or combined with camphor, will, in general, succeed in enabling that organ to retain the bark. The paroxysm may be generally prevented by administering a full dose of the tincture of opium, in mulled wine or hot diluted spirits, about an hour previous to its expected return.

Continued Fever. This is either inflammatory (synocha), putrid or gaol (typhus), or mixed (synochus.)

Symptoms of Synocha. This fever, which,

however, without topical inflammation, is in this country a very rare occurrence, generally commences with short fits of cold and heat alternating with each other, to which succeed an intense burning heat, head-ach, accompanied with throbbing of the temples, or tinnitus aurium, pains in the back, loins, and joints, and the patient feels as if his body had been severely bruised: the face is full and florid; the eyes are inflamed and incapable of bearing the light; the skin, mouth, and throat are dry; the tongue is covered with a white crust; the thirst is intolerable; the respiration is frequent, hurried, generally oppressed, and attended with a dry cough; there is anorexia, nausea, vomiting, restlessness, and delirium; the urine is secreted in small quantity, and is high coloured; the bowels are costive; the pulse is frequent, strong, and hard, scarcely ever, however, exceeding 120 strokes in a minute; the blood, when drawn, is covered with a whitish or yellowish crust. In this country, after the symptoms have continued for some days, they begin generally to assume those of typhus, so that the whole disease is synochus.

Causes. Suppression of the accustomed evacuations; cold by any means applied, as exposure of the body to the cold air, when it is in a state of perspiration; exposure to the rays of the sun; intemperance in eating, but more particularly in drinking; topical inflammation; intense study; great fatigue; the premature repulsion of eruptions; perspiration suddenly checked, and violent passions of the mind.

Diagnosis. This fever will be readily distinguished from the typhus mitior by the strength of the pulse, the intense heat, great thirst, violent pains in the back and joints, high coloured urine, and by the less derangement of the mental functions.

Prognosis. It frequently terminates in a favourable manner about the seventh day, either by hemorrhage, a profuse diaphoresis, or by the urine depositing a copious lateritious sediment; the termination by diarrhœa is a much more rare occurrence. If the respiration be very laborious, if the head-ache be very severe, attended with delirium ferox, if the abdominal viscera be much affected, if the urine be pale or limpid, and the skin assumes a yellow tinge before the seventh day, we may generally expect an unfavourable issue.

Treatment. The removal of this disease must be attempted by blood-letting, in proportion to the violence of the symptoms of increased excitement, strength, and former habits of life of the patient, and nature of the prevailing epidemic; if, on the first blood-letting, the symptoms be considerably alleviated, and the pulse and heat become nearly natural, it will not be necessary to repeat it; if, on the contrary, the symptoms continue with but little or no abatement, it will not only be advisable but indispensably necessary to repeat the operation, until we nearly reduce the pulse and heat to the natural standard; the blood-letting will be the more efficacious, the more suddenly we abstract the blood; an emetic should then be administered, and in a few hours after its operation has ceased, a cathartic should be exhibited, for which purpose the phosphate or sulphate of soda, or the sulphate of magnesia, combined with the infusion of senna, with a small proportion of the tartarised antimony, will be the most efficacious; calomel is a preferable medicine to the others; after the contents of the primæ viæ are sufficiently evacuated, we should order the neutral salts, particularly the saline draughts every two or three hours, to each dose of which, from twenty to thirty drops of antimonial wine, with the same quantity of the spirit of nitre may be conjoined with advantage; cooling mucilaginous liquors acidulated with the vegetable acids, or cold water, should be freely allowed, when the heat of the surface of the body is steadily above the natural standard. It is of the utmost consequence, throughout the whole course of this disease, that the alimentary canal should be kept clear of feculent matter; for which purpose the mildest laxatives should be employed, or perhaps mucilaginous clysters would be preferable; all exercise, both of the body and mind, must be studiously avoided, the patient must be kept quiet and in a horizontal posture, the light should be as much as possible excluded, there should be a free circulation of cool air through the apartment, the floor of which should be frequently sprinkled with cold water, the patient should be lightly covered with bed-clothes, all excremental matters should be speedily removed, and the patient should have frequent changes of dry linen. If the pain of the head be very violent, accompanied with delirium, or, if the patient is oppressed with coma, blood-letting, both general and topical, will be necessary, provided the strength of the patient is not too much exhausted; cathartics and laxative

clysters must be ordered, the head should be shaved, and cooling applications, as vinegar and water, or a solution of the volatile salt of hartshorn in vinegar, and the like, must be employed; blistering the head, and fomenting the lower extremities will also be of service. If the respiration should be much oppressed, and attended with a short, dry cough, we must immediately have recourse to blood-letting, both general and local; blisters should be applied to the thorax, and we should direct a liberal use of mucilaginous diluents. Should the abdominal viscera be attacked in the course of the disease, the same general means of blood-letting and blistering must be employed, together with laxatives or fomentation of the lower extremities. In this climate, after a short period, the symptoms generally begin to assume the typhoid form, therefore some degree of caution will be indispensably necessary in the liberal employment of evacuations, lest we should induce a degree of fatal debility.

Typhus.—Symptoms. An uneasy and peculiar sensation in the stomach, sometimes attended with nausea and giddiness, frequently denotes the approach of this fever. In many cases, however, it is scarcely or not at all perceived, and the disease generally commences with lassitude, languor, some degree of debility, horripilatio or sense of creeping, impaired appetite, alternate and irregular heats and chills, anxiety about the præcordia, and great dejection of spirits, accompanied with frequent sighing. After these symptoms have continued for a few days, the patient is attacked with headach, or an uneasiness and confusion of head; a deep-seated pain, or a sensation of coldness is perceived, particularly in the occiput; there is nausea, vomiting of insipid phlegm, and great prostration of strength; the heat of the body is but little increased; there is little or no thirst; the tongue at the commencement of the disease is moist and covered with a white crust; in the more advanced stages it becomes dry, brown, and chapped; the countenance is pale and sunk, the pulse is small, weak, and frequent, the respiration is oppressed, and attended with great anxiety about the præcordia, the urine is pale, and secreted in too great a quantity. The uneasiness and confusion of head increase with the debility, and prevent the patient from going to sleep; or, if he do, it does not refresh him, and on the second or third night some degree of delirium comes on, which, however, goes off in the morning, and returns in a more severe manner every evening, and during the day he lies in a confused state, or is constantly muttering to himself. All these symptoms go on gradually increasing, followed by tremor of the hands and tongue, muscæ volitantes, picking of the bed-clothes, subsultus tendinum, and convulsions, which generally close the scene.

Causes. The depressing passions of fear, grief, and despair; all excessive evacuations; a relaxed habit of body; immoderate venery; a sedentary and studious life; intemperance in eating and drinking; fatigue; the abstraction of the usual quantity of nourishing food; contagion, and paucity of blood.

Diagnosis. The slow and insiduous appearance of this fever will distinguish it from the typhus gravior: the rigors are less severe; there is a considerably less degree of heat and thirst, and no bilious vomiting; there is also greater mildness in the symptoms, even in the first stage; the skin is pale, and has a bluish and sunk appearance.

Prognosis. The favourable symptoms are, an universal warm moisture of the skin; the tongue from being dry and foul becoming moist; the pulse being rendered more slow and full after a gentle diaphoresis, or the exhibition of cordials; the appearance of an eruption about the lips and nostrils; a miliary eruption, neither preceded by, nor accompanied with, profuse sweating; deafness; a temporary insanity; an increased secretion of saliva without aphthæ; a spontaneous but gentle diarrhœa. The unfavourable symptoms are, a great degree of muscular debility; the early appearance and obstinate continuance of delirium; stupidity and listlessness of the eyes on the first days of the disease; a morbid sensibility of the surface, and of all the organs of sense; profuse evacuations, attended with a weak pulse, tremor of the hands and tongue; feather-hunting; a considerable degree of sighing, mumbling, and moaning; constant watchfulness; coma, accompanied with fulness of the vessels of the tunica adnata, and dilated pupils; a difficulty of swallowing, attended with hiccup; an unconscious discharge of the urine and fæces. Dr. Fordyce observes, in his third Essay on Fevers, p. 141, that, if the respiration and deglutition be free, the prognosis is seldom bad, although the disease may be attended with alarming symptoms.

Treatment. The first step to be taken in

this, as well as in most other febrile diseases, is to clear the primæ viæ of their crude and acrid contents, by the early exhibition of an emetic, which, by the concussion it gives to the whole system, dissolves the morbid catenation, and frequently terminates the disease; in a few hours after that has ceased to operate, a cathartic of calomel should be administered, mixed with a small quantity of conserve, honey, or mucilage, and it should be allowed to remain for a short time about the fauces, before it is swallowed; throughout the whole course of the disease we must procure the regular expulsion of the fæces, by means of the mildest laxatives, or by the injection of clysters every evening; the skin on every part of the body successively should be washed with cold water, or vinegar and water; wine and opium should be administered in small quantities, and repeated every three hours alternately; the application of small repeated blisters will be of considerable service; the administration of oxygen gas will also prove an useful auxiliary. The symptoms which forbid the use of bark are a hot and dry skin, and a parched tongue; it must, therefore, be our object of practice to remove those symptoms as early as possible, which will in general be accomplished by the administration of the saline draughts in a state of effervescence, every two, three, or four hours, combined with the infusion or tincture of snake-root, with from twenty to thirty drops of æther in each draught; warm pediluvia should be ordered in the evenings, or the lower extremities should be fomented; whenever a general relaxation of the skin occurs, the bark, combined with a small portion of the confectio opiata, and a few drops of the muriatic or sulphuric acid in each dose, should be given frequently, taking care at the same time not to oppress the stomach. A table-spoonful of yeast, either diluted or in its pure state, has been of late much employed, and with a considerable degree of success; it should be given at least three or four times in the course of the day. At bed-time it will be proper to give an opiate, particularly if the patient is restless, and its effects will be promoted by combining it with about ten grains of the castor or camphor, or from fifteen to twenty grains of the compound powder of ipecacuanha, or a drachm of Hoffman's æther may be substituted, the last of which medicines, if it does not procure sleep, it do not, however, increase the heat or restlessness: if the hands and feet be at that time parched, the effects of the opium or other remedies will be promoted by moistening them with cold or tepid vinegar. If the head-ach be very distressing, blisters should be applied to the temples: should subsultus tendinum supervene, either æther, camphor, carbonate of ammonia, castor, or the musk, should be administered in large doses alternately with bark: the diet should be light and nourishing; bottled porter and wine should be allowed liberally, taking particular care that not the smallest degree of intoxication ensues: sedative and antispasmodic remedies may also be employed externally by means of friction; they have in many instances produced the most happy effects.

Dr. Currie, in his ingenious and valuable work, entitled "Medical Reports on the Effects of Water in Fevers and other Diseases," vol. i. p. 17, *et seq.* observes, when speaking of the aspersion or affusion of cold water, vinegar and water, or of a saturated brine, "that the safest and most advantageous time for using either the aspersion or affusion (the latter of which he prefers), is when the exacerbation is at its height, which is marked by increased flushing, thirst, and restlessness, or immediately after its declination is begun; and this has led me almost always to direct it to be employed from six to nine o'clock in the evening; but it may be safely used at any time of the day, when there is no sense of chilliness present, when the heat of the surface is steadily above what is natural, and when there is no general or profuse sensible perspiration. It is at the same time highly necessary to attend to the precautions which the employment of this valuable remedy requires: 1. If the affusion of cold water on the surface of the body be used during the cold stage of the paroxysm of fever, the respiration is nearly suspended, the pulse becomes fluttering, feeble, and of an incalculable frequency; the surface and extremities become doubly cold and shrivelled, and the patient seems to struggle with the pangs of instant dissolution. I have no doubt, from what I have observed, that in such circumstances the repeated affusion of a few buckets of cold water would extinguish life. This remedy should, therefore, never be used when any considerable sense of chilliness is present, even though the thermometer, applied to the trunk of the body, should indicate a degree of heat greater than usual. 2. Neither ought it to

be used when the heat, measured by the thermometer, is less than, or even only equal to, the natural heat, though the patient should feel no degree of chilliness. This is sometimes the case towards the last stages of fever, when the powers of life are too weak to sustain so powerful a stimulus. 3. It is also necessary to abstain from the use of this remedy, when the body is under profuse sensible perspiration, and this caution is more important in proportion to the continuance of this perspiration. In the commencement of sweating, especially if it has been brought on by violent exercise, the affusion of cold water on the naked body, or even immersion in the cold bath, may be hazarded with little risk, and sometimes may be resorted to with great benefit. After the sweating has continued some time, and flowed freely, especially if the body has remained at rest, either the affusion or immersion is attended with danger, even though the heat of the body at the moment of using it be greater than natural. Sweating is always a cooling process in itself, but in bed it is often prolonged by artificial means, and the body is prevented from cooling under it to the natural degree, by the load of heated clothes. When the heat has been thus artificially kept up, a practitioner judging by the information of his thermometer only, may be led into error. In this situation, however, I have observed, that the heat sinks rapidly on the exposure of the surface of the body even to the external air, and that the application of cold water, either by affusion or immersion, is accompanied by a loss of heat and a deficiency of re action, which are altogether inconsistent with safety." Under these restrictions, the cold affusion may be used at any period of fever, but its effects will be more salutary in proportion as it is used more early. When employed in the advanced stages of fever, where the heat is reduced and the debility great, some cordial should be given immediately after it, and the best is warm wine. Dr. Currie, when speaking of the internal use of cold water, vol. i. p. 92, *et seq.* directs that "1. Cold water is not to be used as a drink in the cold stage of the paroxysm of fever, however urgent the thirst. Taken at such times, it increases the chilliness and torpor of the surface and extremities, and produces a sense of coldness in the stomach, augments the oppression on the præcordia, and renders the pulse more frequent and more feeble. 2. When the hot stage is fairly formed, and the surface is dry and burning, cold water may be drank with the utmost freedom. Frequent draughts of cold liquids at this period are highly grateful; they generally diminish the heat of the surface several degrees, and they lessen the frequency of the pulse. When they are attended with these salutary effects, sensible perspiration and sleep commonly follow. Throughout the hot stage of the paroxysm, cold water may be safely drank, and more freely in proportion as the heat is further advanced above the natural standard. It may even be drank in the beginning of the sweating stage, though more sparingly. Its cautious use at this time will promote the flow of the sensible perspiration, which, after it has commenced, seems often to be retarded by a fresh increase of animal heat. A draught of cold water taken under such circumstances will often reduce the heat to the standard at which perspiration flows more freely, and thus bring the paroxysm to a speedier issue. 3. But, after the sensible perspiration has become general and profuse, the use of cold drink is strictly to be forbidden. At this time I have perceived, in more than one instance, an inconsiderate draught of cold water produce a sudden chilliness both on the surface and at the stomach, with great sense of debility, and much oppression and irregularity of respiration. At such times, on applying the thermometer to the surface, the heat has been found suddenly and greatly reduced. The proper remedy is, to apply a bladder filled with water heated from 110° to 120° to the pit of the stomach, and to administer small and repeated doses of laudanum."

Dr. Cullen divides this disease into two varieties: typhus mitior, or low nervous fever, being that we have now described; and typhus gravior, jail, camp, or hospital fever, far more violent in its symptoms, rapid in its progress, infectious in its effluvium, and fatal in its tendency. It becomes the medical practitioner, therefore, to be proportionably more bold and active: with which general observation the same mode of treatment may for the most part be pursued. The stimulant plan must be pushed to a much greater extent, and affusions of cold water are here of more use than in the preceding variety, and of course ought to be employed with the most liberal and unhesitating attention.

Synochus.—Symptoms. This, as we have already observed, is a fever compounded of those that characterise the first stage of synocha, or inflammatory fever, with which it commences, and of those which constitute

the middle and last stages of typhus or putrid fever, into which it becomes converted by a sudden and oftentimes a very unexpected change. It is a common fever in the large manufacturing towns of this country; and great care is necessary, on its first appearance, that it be not mistaken for, and consequently treated as, an inflammatory attack, by venesection, and a strict debilitating plan. This is the general caution on its commencement, or while we are in doubt; in its further advance, the treatment must be adapted to the different symptoms it exhibits, as more nearly approaching to the nature of the synocha or typhus, and should be governed by the regulations already laid down for the treatment of these diseases.

Under this genus Dr. Cullen has ranged hectic fever; whilst he makes phthisis, of which he admits it to be only a symptom, under a genus of another order, which he denominates hæmorrhagiæ. It cannot, therefore, be considered as entitled to any notice in the present place, and we shall consequently transfer it to that to which it more properly belongs.

ORDER II. *Phlegmasiæ.* INFLAMMATIONS.

Topical inflammations, or phlegmasiæ, are a very numerous assemblage of diseases: their chief characteristics are the general symptoms of fever, and a topical inflammation, attended with the lesion of some important function; in which, usually after blood-letting, the blood is found upon coagulation to be covered with a buffy coat. This order comprehends the following eighteen genera:—1. Phlogosis, of which, upon the Cullenian system, there are two species; P. phlegmon, and P. erythema, or cutaneous erysipelas. 2. Ophthalmia, inflammation of the eyes. 3. Phrenitis, inflammation of the brain. 4. Cynanche, the sore throat, or quinsy. 5. Pneumonia, inflammation of the lungs. 6. Carditis, of the heart. 7. Peritonitis, of the peritonæum. 8. Gastritis, of the stomach. 9. Enteritis, of the intestinal canal. 10. Hepatitis, of the liver. 11. Splenitis, of the spleen. 12. Nephritis, of the kidnies. 13. Cystitis, of the urinary bladder. 14. Hysteritis, of the womb. 15. Rheumatismus, rheumatism. 16. Odontalgia, inflammatory toothach. 17. Podagra, gout. 18. Arthroponsis, inflammation of the hip.

By far the greater number of these are of the same natural family, and require the same mode of treatment; and several we have already noticed in the article DIETETICS. Whatever be the organ affected, with the very few exceptions we shall presently point out, the inflammation must be attacked with applications both general and topical, and powerful in proportion to the degree of inflammation. Venesection, cathartics of calomel, and laxative injections, may be safely recommended as a part of the general practice. Local bleeding by cupping, wherever it can be employed, and where it cannot, by leeches, should constitute an essential feature of the plan, and be repeated according to the urgency of the symptoms. In most of these diseases benefit may also be obtained by frigid lotions, as of common spring water, ice water, vinegar; while the general symptomatic fever, if considerable, must be attacked by the process of cure already laid down in the treatment of fevers, and varied according to the phænomena that arise. When the cause is obvious, as in many cases of ophthalmia, or inflammation of the intestines, we should be indefatigable till it be removed, since without the accomplishment of this point every thing else must be of no avail. These are general hints. Several of the diseases, however, arranged under this order are connected artificially alone, and not naturally, and require a distinct treatment. We shall briefly notice a few of them.

Erythema. As in this affection, notwithstanding the inflammatory appearance, there is frequently a considerable degree of debility, we must not push the antiphlogistic measures too far, particularly in debilitated habits, and in those advanced in life, for fear of inducing gangrene, but rather trust to wine, bark, combined with snake-root or camphor, and the sulphuric acid, together with local applications. Should there, notwithstanding all our efforts, be a tendency to gangrene, we should stimulate in a still higher degree; on the other hand, should there be any considerable danger of excitement, which, however, is rarely the case, accompanied with a hard, full, and strong pulse, blood-letting, repeated according to the violence of the symptoms, and effects produced will be necessary; at the same time, it will be advisable to employ gentle cathartics: but the bark will usually be found the most efficacious remedy in every stage of this disease.

Cynanche, Quinsy. Of this genus the Cullenian system makes five species. 1. C. tonsillaris, common inflammatory sore throat.

2. C. maligna, malignant sore throat, chiefly symptomatic of scarlet and other fevers of a putrid tendency. 3. C. trachealis, croup; a disease most commonly of infancy. 4. C. pharyngea, a mere variety of C. tonsillaris, by its being extended to the pharynx. 5. C. parotidæa, mumps; generally a slight inflammatory affection, and lasting only a few days, of the parotid and maxillary glands; though sometimes succeeded in men by symptomatic intumescence of the testes, and in women induration of the mammæ, usually, however, yielding to repellent applications and gentle aperients. If the head be affected by stupor, or delirium, from a similar sympathy, it should be bathed with warm water, and a few ounces of blood, according to the strength of the patient, should be taken from the arm.

Generally speaking, indeed, the common means employed in the removal of other local inflammations, with the use of acid gargles, is the plan to be adopted in Cynanche; yet the two following species require to be noticed separately.

C. trachealis. This disease very rarely attacks infants until after they have been weaned; it generally commences with a sensation of uneasiness, or somewhat of an obtuse pain about the upper part of the trachea, which is increased on pressure, or a sense of constriction is perceived in the neighbourhood of the larynx; upon inspecting the fauces, little or no tumour is generally observed, sometimes, however, there is some trifling degree of redness; a hoarseness and particular ringing, shrill sound of the voice accompanies both speaking and coughing; the noise appears to proceed as from a brazen tube, and has been, not inaptly compared to the crowing of a cock; there is dyspnœa, attended with a wheezing sound in the act of inspiration; the cough which attends the disease is commonly dry and short; if any thing be expectorated, it is puriform, and mixed with small portions of a whitish membrane, similar to what is found in the trachea upon dissection, which is, by that illustrious anatomist and physician, Dr. Baillie, supposed it to be formed by some peculiar action of the blood vessels of the inner surface of the larynx and the trachea, which is superadded to inflammation, the face is somewhat livid, or is flushed. With these symptoms there is some degree of frequency and hardness of the pulse, great thirst, restlessness, and an unpleasant sense of heat; the deglutition is but little or not at all affected; the urine, at the commencement of the disease, is generally high coloured; sometimes, however, it is limpid; but in the advanced stage it is turbid: there is seldom any delirium; sometimes, however, the patient seems stupid, and mutters to himself, and often in the perfect use of his senses he is seized with great difficulty of breathing, and a sense of strangling about the fauces, and is suddenly carried off. This disease chiefly appears in the winter and spring; it generally attacks the most robust and ruddy children, and frequently comes on with the ordinary symptoms of catarrh. The remote causes are cold, combined with a moist state of the atmosphere; infancy; exposure to air passing over large bodies of water, and many of the causes producing the Phlegmasiæ, and the other species of Cynanche. It is said to be most frequently met with in marshy situations, and near the coast. The proximate cause appears to consist in an inflammation of the inner coat of the trachea and the larynx, together with an altered and peculiar action in the blood vessels of the parts; and the adventitious membrane is the consequence.

Treatment. We must attempt the cure of this disease by the remedies which are recommended for the removal of inflammation; blood-letting, both general and topical, must be immediately had recourse to, and it must be repeated according to the strength of the patient, violence of the symptoms, state of the pulse, and the effects produced from it: repeated emetics should be administered, and mild cathartics or laxative clysters should be at the same time employed; blisters should be applied to the external fauces, or stimulating liniments, as the liniment of ammonia with oil of amber and tincture of cantharides should be made use of; the warm bath should be ordered, and the vapour of warm water, with or without a portion of vinegar, should be frequently received into the fauces; in every stage of the disease the antiphlogistic regimen is peculiarly necessary, and the patient should lie with his head raised high in bed: small repeated doses of calomel have been administered with the best effects, at the commencement and throughout the whole course of the disease, as two or three grains two or three times in the course of the day. This disease sometimes attacks adults; in which case the most powerful remedies against inflammation, together with the employment of emetics, must be immediately had recourse to, and persevered in;

with assiduity. There appear to be two varieties of this complaint; the one just now described, which may be termed the inflammatory, and the spasmodic; which, from their different requisite mode of treatment, it will be necessary to discriminate. The inflammatory Cynanche commonly attacks the patient in a gradual manner, and is generally preceded for a few days by slight symptoms of pyrexy; it never, when completely formed, intermits so as to lose its distinguishing mark, particularly in coughing: the heat, frequency of the pulse, and other symptoms of pyrexy, are in a much greater degree in this than in the spasmodic species. The spasmodic Cynanche always attacks the patient in a sudden manner, and usually in the night-time: it often intermits, and in the intervals both the respiration and cough, if any exists, are free from the characteristic sound of the above disease; it must, of course, be treated with antispasmodics, as the musk, camphor, asafœtida, the warm bath, and similar remedies.

C. maligna, malignant, or putrid sore throat. This disease, whether primary or symptomatic, is marked by frequent cold shiverings, alternating with fits of heat, giddiness, lassitude, anxiety, depression of spirits, nausea, and vomiting: these symptoms seldom continue long, before the patient complains of a sense of stiffness in the neck, some uneasiness in the internal fauces, and hoarseness; the internal fauces, when viewed, appear of a dark red colour, are but little, or not at all swollen, and deglutition is seldom attended with difficulty or pain. In a short time, a number of white, ash-coloured, or brown spots, make their appearance upon the inflamed parts; these spread, run together, and cover the greatest part of the fauces with thick sloughs, which, upon falling off, discover deep ulcerations. As the disease advances, these symptoms are generally attended with a coryza, which pours out a thin, acrid, and fetid matter, which excoriates the nostrils, lips, and sometimes every part it touches; in infants diarrhœa is a more frequent occurrence than in adults, and the thin acrid matter evacuated excoriates the anus and neighbouring parts. The fever increases with the other symptoms; the skin is dry, parched, and accompanied with a biting heat; the eyes become red, heavy, and watery; the countenance is either full and bloated, or pale, shrunk, and dejected, and the patient frequently complains of an unusual sense of oppression and debility; the pulse is small, frequent, and irregular; the respiration is more or less hurried, and as the disease advances, the breath becomes very fetid, and is often disagreeable to the patient himself; and there is generally a considerable discharge of a sanious-like matter from the fauces; the voice is frequently very much altered, and when the inflammation has attacked the organs of respiration, it assumes a wheezing or ringing sound, the respiration becomes difficult, and the patient is teased with a troublesome cough; the fever suffers an evident exacerbation in the evening, during which some rattling is perceived in the breathing, and there is generally a remission in the morning; great debility, prostration of strength, and restlessness, accompanied with frequent sighing, as in the Typhus Gravior, supervene, and, if neither delirium nor coma appeared at an early period, they generally come on in the progress of the complaint. On the second or third, rarely later than the fourth day, an eruption appears upon the skin, which, for the most part, in the first instance, shews itself upon the neck and breast; it comes out in blotches of a dark purple or raspberry hue, and gradually spreads over the trunk and extremities; the scarlet redness is often considerable on the hands and extremities of the fingers, which feel stiff and swelled; the stains, when nearly inspected, appear to be composed of small prominences, which may sometimes, although rarely, be distinguished by the eye, more frequently by the touch only; the eruption is as irregular in its appearance as it is in its steadiness and continuance; it generally, however, disappears about the fourth day, and a desquamation of the cuticle takes place: but neither on its first appearance, nor on its desquamation, does it always produce a remission of the fever or of the other symptoms, except the vomiting, which generally abates on its first appearance. As the disease advances, the ulcers on the fauces become of a livid or black colour, the pulse becomes more depressed, and the symptoms attending the latter stages of the Typhus Gravior come on, and the patient is generally cut off either by a diarrhœa, or by a profuse hæmorrhage from the intestinal canal, nose, mouth, or ears, often on the third day, sometimes later, but for the most part before the seventh. The complaint sometimes spreads into the trachea; the parotid and the other lymphatic glands also in the vicinity of the fauces, in consequence of the

absorption of the putrescent matter, are sometimes so much swollen as to endanger or induce suffocation.

Causes. This disease is produced by a specific contagion, and those will be more liable to be attacked by it who are of a sickly habit of body, and who have been exposed to the remote causes of the Typhus Gravior. It has been frequently observed of this, as of most other epidemics, that it is most fatal on its first appearance, gradually becoming milder till towards the end, when it is attended with scarce any danger; at the same time other complaints seldom prevail much while it rages, or if they do, are generally catenated with its symptoms.

Treatment. In the management of this often fatal and insidious disease, we must keep its tendency to depression of strength and gangrene constantly in view, and at the same time attend to certain troublesome symptoms which frequently accompany this disease. Emetics, at the commencement, must on no account be dispensed with; but as in this species of Cynanche there is so great a tendency to diarrhœa, they should in general consist of ipecacuanha only: sometimes, however, a small portion of Dr. James's powder may be added with advantage. The intestinal canal must be evacuated by the most gentle laxatives, for which purpose the mercurial cathartics are particularly recommended; in the more advanced stages of the disease they will be improper, as there is generally a spontaneous diarrhœa: the regular expulsion of the feces should be solicited by clysters only; but towards the termination, when the bowels are loaded with putrid sordes, accumulated in them during the disease, which protracts the fever and impairs the appetite, gentle cathartics will be serviceable: even in this case we must not venture to employ them, unless the fauces have a healthy appearance, and there is a considerable abatement of the febrile symptoms. Small repeated blisters should be applied to the external fauces: rubefacients, however, may in general be employed with equal advantage and more safety. The fauces must be preserved from the effects of the acrid matter discharged from the ulcers by the diligent use of antiseptic, or rather stimulating gargles, as the decoction of bark with muriatic or sulphuric acid, or the bark in port wine, a small quantity of which should be frequently employed or injected into the fauces by means of a syringe: a small quantity of a gargle, composed of alum, in the proportion of an ounce to a pint of water, is recommended to be frequently injected into the fauces, which is said to remove the fetor from the ulcers. But the most powerful gargle is prepared by mixing a tea-spoonful or two of the capsicum annuum, or Guinea pepper, and a tea-spoonful of sea-salt, with three ounces of distilled vinegar, and the same quantity of boiling water, a small quantity of which is advised to be taken into the fauces every two hours, so as to produce and keep up a moderate degree of excitement on the tonsils, uvula, and fauces. Wine, opium, bark, mineral acids, and the other remedies recommended in the treatment of the Typhus Gravior, must be employed with assiduity. As children can rarely be prevailed upon to take the necessary medicines in sufficient quantities, the bark and cordials should be exhibited by clysters. Diarrhœa is to be checked by opiates and astringents, excepting it arise as a salutary crisis towards the close of the disease, in which case rhubarb in gentle doses is the very best moderating remedy.

Rheumatismus, Rheumatism. Of this disease there are two species, the *Acute* and the *Chronic*. The former generally commences with the usual symptoms of fever, preceded or succeeded by acute and pungent pains in the joints: the pain is not, however, confined to the joints; but it frequently shoots along the muscles from one joint to another: the parts most commonly affected are the hips, knees, shoulders, and elbows, more rarely the ankles and wrists: the pain is much increased upon the slightest motion, or even by the heat of the bed: there is some degree of swelling and redness in the parts most affected, which are painful to the touch: the pulse is frequent, full, and hard: generally costive: the urine at the commencement of the disease is high-coloured, and generally without sediment; but on the remission of the symptoms it deposits a lateritious one, and there is a tendency to sweating in the course of the disease, which rarely brings relief: an exacerbation of the febrile symptoms takes place every evening, and a remission towards morning, and the pains are most severe and most apt to shift their place in the night-time. Dr. Darwin suspects that rheumatism is not a primary disease, but the consequence of the translation of morbid action from one part of the system to another, which idea, he observes, is countenanced by the frequent change of place in rheumatic

inflammation, and from its attacking two similar parts at the same time, as both ankles and both wrists, and these attacks being in succession to each other: and he further remarks, that this accounts for rheumatic inflammation so very rarely terminating in suppuration, as the original cause is not in the inflamed part; but, instead of suppuration, a quantity of mucus or coagulable lymph is formed on the inflamed membrane, which is either re-absorbed, or lies on it, producing pains on motion long after the termination of the inflammation.

The remote *causes* of this disease are, frequent vicissitudes of the weather; cold suddenly applied to the body when under perspiration; the long continued application of cold, particularly when combined with moisture, as when damp or wet clothes are applied to the body or extremities for any considerable length of time; plethora; cold caught when the system is under the influence of the hydrargyrus; certain seasons of the year, as spring and autumn. The proximate cause is supposed to be an inflammation of the membranes, and tendinous aponeuroses of the muscles.

The *cure* of this species of the disease will be effected by removing the morbid excitement, by a strict adherence to the antiphlogistic regimen, by blood-letting, which must be repeated in proportion to the degree of strength and hardness of the pulse, and violence of the symptoms: we must not, however, push general evacuations too far, as they not only retard the recovery of the patient, but frequently induce an obstinate chronic state of the disease: topical evacuations, by means of leeches or cupping, may, after general blood-letting, be advantageously employed when the pain becomes fixed in the joints, attended with some degree of redness and swelling: gentle saline or mercurial cathartics, or laxative clysters, should be frequently administered: a gentle diaphoresis should be excited by means of the neutral salts, or of saline draughts combined with nauseating doses of tartarised antimony and the sulphuric or nitrous spirit of æther, or camphor may be employed in combination with volatile salt of hartshorn: cooling mucilaginous diluents are to be taken freely: the diet should consist of food of little stimulus, and the cure will be further promoted by the warm bath. When the excitement has been subdued, bark, combined with chalybeates, and myrrh or opiates, combined with ipecacuanha, may be administered with great advantage: rubefacients are of service, and blistering should be employed when the excitement is considerably reduced, and the pain is much confined to one part. Bark has of late been recommended to be administered in every stage of the disease, and there is no doubt that it may be employed, not only with great propriety, but with safety, if the pain be attended with distinct remissions, and assumes more or less the form of an intermittent: when the excitement, however, is considerable, it will be advisable to premise some general evacuations.

The remote *causes* of *Chronic Rheumatism* are preceding acute rheumatism, cold applied partially to the body when heated, and most of the causes producing the other species. The proximate cause is supposed to be atony of the blood-vessels and muscular fibres of the part affected, together with some degree of rigidity and contraction in those fibres: and the removal of this complaint must be attempted by restoring the activity and vigour of the part affected, and also that of the system in general, by the usual remedies for this purpose; and especially by the use of guaiacum and other warm resins, mustard-seed, and horse-raddish; with a local application of volatile liniments and the flesh-brush. The warm bath, or Buxton waters, may also be employed with advantage.

Podagra.—Gout. Of this disease there are four species or varieties, the regular, atonic, misplaced, and retrocedent: it is not necessary, however, to dilate upon each separately.

This disease sometimes makes its attack without any previous warning: in general, however, the inflammation of the joint is for some days preceded by great languor and dulness both of body and mind, doziness, giddiness, wakefulness, or unrefreshing sleep, wandering pains, a deficiency of moisture in the feet, and there is sometimes a coldness, numbness, and sense of prickling in the feet and legs: these symptoms are often, in a greater or less degree, accompanied with frequent cramps of the muscles of the legs and toes, an universal turgescence of the veins, occasional chills, acidity and flatulence in the stomach, and an increased or impaired appetite. The appetite is, however, frequently more keen than usual on the day preceding the attack of the fit. On going to bed, the patient enjoys his usual natural sleep until about two or three o'clock in the morning, when he is

awakened by a very acute pain, most commonly in the first joint of the great toe: sometimes, however, it attacks other parts of the foot. The pain resembles that of a dislocated bone, and is attended with the sensation as if all but cold water was poured upon the part. There is at the same time more or less of a cold shivering, which abates as the pain increases in violence, and is succeeded by a hot fit. The pain, from the commencement, gradually becomes more violent: it is sometimes so acute, as to be compared to a dog gnawing the part, and that and the fever continue in the same state, accompanied with great restlessness, till next midnight, when they gradually remit, and after a continuance of twenty-four hours from the commencement of the paroxysm, they commonly cease entirely: the patient falls asleep, during which a gentle perspiration generally comes on, and on waking he finds the part affected somewhat red and swelled. For some days the pain and fever return in the evening, but with a less degree of violence, and a remission takes place towards morning; and after these symptoms have continued for about ten or fourteen days, gradually becoming less severe, they generally cease altogether. Costiveness, an impaired appetite, chilliness of the body towards evening, are also to be reckoned among the symptoms of this disease.

The indications of cure are, in the paroxysms, to moderate their violence and shorten their duration as much as can be done with safety; and in the intervals to prevent the return of the paroxysms, or to render them less frequent and more moderate. The violence of the paroxysm will be moderated by blood-letting, which must be repeated according to the state of the pulse and degree of excitement, where the constitution is not worn down by repeated attacks; leeches should be applied to the inflamed parts, and gentle cathartics should be administered: these parts should also be exposed to cool or cold air, and diluting liquids should be taken freely: the antiphlogistic regimen must be strictly adhered to: abstinence from wine, spirits, fermented liquors, and stimulating food, should be carefully enjoined, unless the system is very much debilitated; in which case a more nourishing diet, and a small quantity of wine or of diluted spirits may be allowed: after the excitement has been subdued by proper evacuations, blisters may be employed with advantage; they are recommended by that enlightened physician, Dr. Rush, to be applied to the legs and wrists: burning with moxa may be advised, or a cabbage-leaf applied to the part affected will often afford considerable relief; bootlets made of oiled silk, are an useful application to gouty joints: when the violence of the symptoms is abated, opiates may be given with advantage, when the pain only returns during the night, and prevents sleep. When the constitution is broken down by repeated attacks of the disease, evacuations must be employed with caution, and it will in general be more advisable and safe to allow some animal food, and wine or diluted spirits: the parts affected should at the same time be wrapped in flannel, fleecy hosiery, or new-combed wool, and a gentle diaphoresis should be excited. When a swelling and stiffness remain in the joints, after the paroxysm has ceased, they will be removed by the diligent use of the flesh-brush, gentle exercise of the parts, and the Buxton or Bath waters, taken at the fountain head; and where the gout has left a number of dyspeptic symptoms, the latter may be drank with considerable advantage. Purging immediately after a paroxysm will be very apt to induce a relapse. In the intervals we must endeavour to prevent a return of the paroxysms, or to render them less violent: 1. By temperance, which should be regulated according to the age, habits of life, and constitution of the patient. It is very probable that a diet, consisting of milk, vegetables, and water, would prevent the recurrence of the disease; but in general fish, eggs, the white meats, and weak broths, may be taken in small quantities once a day, and a little salted meat may be eaten occasionally, and weak wine and water, or small beer, may be taken at meals. As there is a disposition in the gout to return in the spring and autumn, a greater degree of abstinence in eating and drinking will be necessary at those seasons than at any other period: and if any of the premonitory symptoms are then present, and the vigour of the system remains unimpaired, the disease may be often prevented from occurring by the loss of a few ounces of blood, or perhaps by an emetic or a gentle cathartic, and afterwards bathing the feet in warm water: a full dose of the tincture of opium might probably be of service. In the decline of life, or when the constitution is much debilitated, this abstemious mode of living must be commenced with caution, as it might be the means of inducing more

violent and dangerous fits of the gout. 2. By moderate labour and gentle exercise, as riding on horseback; but more particularly walking. 3. By avoiding cold, especially when it is combined with moisture. The feet should be kept constantly warm and dry by means of socks and cork-soled shoes, and the patient should wear flannel next to the skin. 4. By the prevention of costiveness, by means of gentle laxatives, as aloetics combined with soap and rhubarb, or oil of castor. 5. By tonics, as the bark, quassia, and chalybeates. 6. By the exhibition of alkalies in various forms, as the fixed alkali, both mild and caustic, lime water, soap, and the absorbent earths; and, lastly, by studiously avoiding the exciting causes. In the retrocedent species, strong stimulants, both external and internal, should be instantly employed with an unhesitating hand; and in the atonic species the diet should be peculiarly generous, and compounded of spices and other aromatics.

Order III. *Exanthemata.* Eruptive Fevers.

These consist of the following genera: 1. Erysipelas, or St. Anthony's fire. 2. Pestis; plague. 3. Variola; small pox. 4. Varicella; chicken-pox. 5. Rubeola; measles. 6. Miliaria; miliary fever. 7. Scarlatina; scarlet fever. 8. Urticaria; nettle-rash. 9. Pemphigus; bladdery fever. 10. Aphthæ; thrush. The whole of this order is defined by Cullen to consist of diseases affecting persons only once in their life, commencing with fever, and succeeded by phlogoses, generally small in size, considerable in number, and dispersed over the skin. The definition, however, will not hold good in several of its clauses, and especially in its first; for, perhaps, there is not a single disease in the list, but what has occasionally recurred, and many of them repeatedly. It is to be remarked, through the whole of these, that, whatever danger may accompany them, depends rather upon the degree of fever, and the nature of the fever that introduces them, than upon the extent or nature of the eruptions themselves: and hence, with very few exceptions, the general plan laid down for the treatment of the different genera, in the order Febris, is the plan which ought to be followed in the order before us. Thus the fever accompanying plague is evidently typhus, which, in effect, when accompanied by eruptions of any kind, is evidently a typhoid eruptive fever, and requires the same treatment as typhus. Chicken-pox, and nettle-rash, have a near approach to synocha, and so far possess the same indications; but they are generally slight diseases, and of not more than three days' duration. The rest, for the most part, are of a mixed breed, and have hence a closer resemblance to synochus: they commence with inflammatory affections; but have soon a strong tendency to run into the putrid type. We shall select an example or two from the diseases of this order, either most important or most frequent.

Variola. Small-pox. This is of two varieties, the distinct and the confluent. The general nature, symptoms and treatment of the former, are so well known, that it is unnecessary to repeat them. In the confluent kind, our chief attention must be directed to support the strength of the system, and to obviate the tendency to great depression of strength and putrefaction of the fluids, which will be effected by the exhibition of cordials, wine, bark, mineral acids, and a nourishing diet, and by all the means recommended in the treatment of typhus, except the application of cold water after the appearance of the eruption; the bowels should be kept regular by the mildest cathartics, or by laxative clysters; some authors, however, recommend a more liberal use of them, unless a diarrhœa has supervened, even when the disease assumes the type of typhus. When the disease is attended with violent symptoms, blisters should be applied in succession, on different parts of the body, without regard to the parts being covered with pustules; if there be obstinate vomiting, the saline draughts should be given in a state of effervescence; or camphor, combined with opium, may be employed with advantage; the extract of cascarilla, administered in some aromatic liquid, is often of use in allaying the vomiting; and if we do not succeed by those means, it will be proper to apply a blister to the region of the stomach: should the epileptic fits continue violent, it will be necessary to administer opiates, both by the mouth and by clysters, which act, not only by their antispasmodic power, but also by perspiration, and mustard cataplasms should be applied to the feet, at the same time gentle cathartics will be necessary, as the recurrence of the fits frequently proceeds from the irritation of retained feces, especially in children: when a retrocession of the eruption happens, wine, opium, volatile alkali, musk, and camphor, with the warm

bath, are the remedies most generally employed; blisters and mustard cataplasms should also be applied to the lower extremities: if the swelling of the face subsides suddenly, and is not succeeded by the swelling of the hands, blisters are recommended to be applied to the wrists and fore-arms; anointing great part of the body with mercurial ointment, or applying a large mercurial plaster to the scrobiculus cordis under the same circumstances, is often attended with good effects; if the salivation suddenly cease, without any swelling of the hands, blisters should be applied to the wrists, and small doses of ipecacuanha should be administered: should there be a suppression of urine, the patient should be exposed to a current of cool air; if this does not succeed, and he is not in a very debilitated state, and the heat of the body is steadily above the natural degree, it will be proper to dash cold water upon the legs; and perhaps to extend the affusion over the whole surface.

Rubeola. Measles. This disease will be distinguished from the other exanthemata, by the dry, hard cough, hoarseness, sneezing, watering of the eyes, coryza, dyspnœa, and great drowsiness, or coma. From catarrh, the greater violence of the febrile symptoms, the greater affection of the eyes, and many of the symptoms accompanying the eruptive fever of measles, particularly the coma, will afford a ready diagnosis between the two diseases.

The *remedies* indicated in the cure of this disease are such as will obviate, or remove the morbid excitement; blood-letting will therefore be requisite in proportion to the violence of the fever, cough, and dyspnœa, if the nature of the prevailing epidemic does not contra-indicate; but as the danger, at the commencement of the complaint, is for the most part inconsiderable, that powerful remedy may, unless the excitement is very great, and threatens immediate danger, or much subsequent debility, generally be reserved till after the period of desquamation, which is often succeeded by a more dangerous train of symptoms than any that have preceded; gentle cathartics are indispensably requisite in all cases, such as phosphate of soda, Epsom salts, infusion of senna, &c.; analogy is, however, greatly in favour of calomel; tepid mucilaginous diluents should be freely allowed; it will be adviseable to excite a gentle diaphoresis by means of the saline draughts, with small doses of tartarised antimony; the cough will be alleviated, and expectoration promoted by a solution of spermaceti, gum arabic, or of the pulvis tragacanthæ compositus, or the decoctum hordei compositum may be employed in considerable quantities; inhaling the vapour of hot water, the application of oil round the chest, and the pediluvium, or warm bath, will be found useful auxiliaries: should the cough and dyspnœa prove urgent, attended with pyrexia, or should they remain after the desquamation, blood letting, either general or local, should be employed: we must, however, be cautious in reducing the strength of the patient; small blisters should be applied in succession about the thorax; the apartment in which the patient continues should be kept cool; he must not be exposed to cold air so freely as in the small-pox, as much disorder may be produced in the system, if, from such exposure, retrocession of the eruption should take place; the degree of temperature should therefore in a great measure be regulated by the patient's feelings: when the excitement is subdued by evacuations, and the cough remains the only troublesome symptom, opiates may then be given with great advantage; and at this period of the disease, a change of air will be of the most essential service. As a morbid tendency remains for some time after this complaint, it will be not only advisable, but indispensably necessary, to administer gentle cathartics at proper intervals. If symptoms of pneumonia should supervene after the desquamation, blood-letting, both general and local, if the strength of the patient will admit of it, blisters and the other remedies, which are mentioned when treating of that inflammation, must be diligently employed: when a diarrhœa remains troublesome, after the desquamation has taken place, it must not be checked too hastily by the employment of astringents and opiates, on account of the tendency to inflammatory complaints which remains after the measles: the cascarilla, or columba may, however, be employed in small doses, before we have recourse to more powerful astringents; blood-letting will generally remove both the diarrhœa and cough; it will, therefore, be advisable to endeavour to check the diarrhœa by that evacuation, rather than employ astringents in the first instance. The putrid measles appeared in London in 1672, 1763, and 1768, and have appeared occasionally since: in this variety all the symptoms are more violent, accompanied with

greater depression of strength; the remedies must be of the same kind, but more actively and instantaneously employed.

Scarlatina. The general nature and treatment of this disease will be found in *Typhus*, and *Cynanche Maligna*.

Erysipelas. St. Anthony's Fire. This will be readily distinguished from the scarlatina cynanchica, by the absence of the pain, redness, tumour, and sloughs in the fauces and tonsils, and by the other concomitant symptoms. The danger will be in proportion to the violence of the symptoms denoting a tendency to an affection of the brain; the parts which were red becoming suddenly pale, and a considerable degree of coma or delirium, particularly at the commencement of the disease, with an increase rather than diminution of it, after the appearance of the eruption, are symptoms of the utmost danger. When the disease terminates in a favourable manner, there is sometimes a gentle diaphoresis; more frequently, however, the disease goes off without any evident crisis.

In the *removal* of this disease, if there be a considerable degree of excitement, attended with much coma or delirium, and a strong, full, and hard pulse, blood-letting will be necessary, and it should be repeated according to the urgency of the symptoms, strength of the patient, and state of the pulse; an emetic should be given at the commencement of the fever, unless the head is affected, in which case it is at least a doubtful remedy; cooling purgatives are particularly useful; mild diaphoretics, assisted by the plentiful use of mucilaginous acidulated diluents, will be proper; the antiphlogistic regimen must be strictly adhered to, and the patient should be placed in as erect a posture as he can bear without inconvenience; if the delirium, but more particularly the coma, be urgent, blisters should be applied to the shaved head, or between the shoulders; cupping should be advised, and mustard cataplasms should be put upon the soles of the feet. The erysipelatous eruption sometimes shews itself in typhus, and increases the fever, in which case we must have immediate recourse to bark, wine, cordials, the sulphuric acid, and the other remedies for that disease. When the eruption returns periodically, issues, and a low diet will frequently prevent it.

ORDER IV. *Hemorrhagiæ*; or SANGUINEOUS FLUXES.

These are thus ordinarily defined; pyrexy, with a flow of blood without external violence; the blood, upon venesection, exhibiting the same appearance as in *phlegmasiæ*. The *genera* are: 1. Epistaxis; bleeding from the nose. 2. Hæmoptysis; spitting of blood. 3. Hæmorrhois; piles. 4. Menorrhagia; immoderate menstruation. These, for the most part, and when the profusions are not merely symptomatic or critical, are a natural class of diseases; and, excepting in one or two instances, are to be attacked by a general plan of a similar kind and tendency. They are preceded, for a longer or shorter time, by a sense of fulness and tension in the parts whence the blood is about to issue: if those parts be visible, there is redness, tumour, a sense of heat or itching, and of pain and weight; internally, in the neighbourhood, there is a similar sense, weight, fulness, tension, heat, and pain; and when these symptoms have subsisted for some time, a cold fit comes on, attended with weariness of the limbs, pains of the back and head, costiveness, and other febrile symptoms, succeeded by a hot fit, in the course of which the blood most commonly flows in a greater or less quantity, and after an uncertain time it ceases spontaneously; during the hot stage, the pulse is frequent and full, and in many cases hard, but as the blood flows, the pulse becomes softer and less frequent, and the blood, when drawn from a vein, appears as in the cases of the phlegmasiæ. After an hæmorrhage has once occurred, it frequently observes periodical returns.

The remote *causes* are, a plethoric and sanguine temperament; the suppression or diminution of accustomed evacuations; changeable weather, as spring and autumn; considerable and sudden diminution in the weight of the atmosphere; external heat; violent exercise of particular parts of the body; whatever increases the force of the circulation, as violent exercise, violent efforts, anger, and other violent active passions; postures of the body increasing determinations to, or ligatures occasioning accumulations in particular parts of the body; a determination to certain vessels rendered habitual from the frequent repetition of hæmorrhage; mal-conformation of particular parts; and lastly, cold externally applied, as changing the distribution of the blood, and determining it in greater quantities into the internal parts; or, perhaps, by its exciting some degree of synocha. The proximate cause is supposed to be congestion in particular parts of the sanguiferous system, occasioning distention of these ves-

sels, and violent re-action, the consequence of which is a rupture of them.

Treatment. When an hemorrhage has taken place, and threatens to go to excess, we must endeavour to moderate or check the flow of blood, and prevent its return; the first indication will be answered by a strict adherence to the antiphlogistic regimen, therefore the removal of every cause of irritation is always necessary, the patient must be kept quiet and still, heat must be particularly guarded against, he should be freely exposed to the cold air, and should be allowed cold or iced water, or iced lemonade to drink; every exertion of mind or body is to be avoided; a vegetable diet will be most proper, unless the strength of the patient is greatly exhausted, in which case, mild broths, and the mildest kind of animal food may be allowed; gentle carthartics, or laxative clysters, will be necessary to prevent any accumulation of the fæces, and blood-letting will be requisite, if there is a considerable degree of excitement; dry-cupping is frequently useful, and blisters may be employed with advantage: vomiting is a powerful remedy in diminishing the action of the heart and arteries; the digitalis, however, in our opinion, is a preferable remedy; refrigerents should be ordered, as the sulphuric acid, nitre, cream of tartar, and the vegetable acids; the first of which is, however, the most efficacious medicine. Internal and external astringents must also be employed; of the former class are the vitriolic acid, alum, and the sugar of lead, which is by far the most powerful remedy, and may occasionally be exhibited with advantage in small doses, but the long-continued use of this remedy is often attended with dangerous consequences, and it should be given in combination with the opium pill, or some tenacious extract, in order to obviate its pernicious effects on the stomach and bowels. The external astringents in most general use, are, cold applied suddenly, cold water in which salt has been recently dissolved, or powdered ice, or solutions of sugar of lead, alum, or white vitriol, &c.; pressure is a powerful means of checking hemorrhage, when it can be applied to the part; when the hemorrhage is very profuse, it is improper to employ any means to prevent syncope, unless it partakes very much of the passive state, in which case it must be prevented by every possible means; the cinchona, with chalybeates, are indicated under the same circumstances. When the phlogistic diathesis is taken off, either by the continuance of the hæmorrhage, or by proper remedies, opiates may be given with advantage, and should subsultus tendinum, or convulsions supervene, they are particularly serviceable, combined with the camphor, castor, and musk. The return of the hemorrhage is to be prevented by our counteracting or preventing a plethoric state of the system, by an abstemious diet, or by taking food of a less nutritious quality, by exercise, gestation will be generally more safe than walking, by gentle cathartics, by cold bathing, bitters, and aromatics, which tend to prevent plethora, by increasing the tone of the vessels, and by studiously avoiding the remote causes; tonics, which much increase the force of the circulation, although indicated, are doubtful remedies, in particular, bark and chalybeates; astringents are in general more efficacious, particularly the sulphuric acid, alum, &c. If the plethoric state, notwithstanding our endeavours, should become considerable, and a return of the hæmorrhage is threatened, blood-letting, both general and local, and blisters, will be proper when the vis a tergo is great, but when the habit is debilitated, it will be more advisable to employ only local blood-letting and blisters; it will be proper to remark, that blood-letting should always precede the employment of blisters.

These directions will suffice for the treatment of hæmorrhagies in general. Upon menorrhagia we shall enter more fully in the article MIDWIFERY, and shall only in the present place offer a few words on phthisis.

Phthisis; or Pulmonary Consumption: upon the Cullenian system is made a species of hæmoptysis. The impropriety of thus naming a disease from a single, and that only an occasional, symptom, must be obvious to every one. But our only duty at present is to describe the disease. This then is generally preceded by more or less of the following symptoms: a slight degree of fever, increased by the least exercise; a dry burning heat of the palms of the hands, particularly towards evening, and of the soles of the feet towards morning; moisture of the eyes after sleep; irregular flushings; hoarseness; a dry, troublesome, and sonorous cough, occasioning slight pain or stitches, most commonly in the sides; some degree of hardness of the pulse; lacinating or fixed pains in the thorax; head ach; frequent fainting fits; some degree of dyspnœa, increased on using exercise; an expectoration of a small quantity of thin, frothy matter; impaired

appetite; restless nights, and universal disinclination to motion or exercise; this may be termed the inflammatory or first period. In a short time the fever becomes more severe, with accessions in the afternoon or evening, and some remission in the morning; the pulse, however, is even then quicker than natural: the cough is increased by a recumbent posture, and prevents sleep till towards morning, when a slight moisture appears upon the breast and upper parts of the body; the expectoration increases in quantity, is frothy, and sometimes streaked with blood; the face is commonly pale, but during the fever the cheeks appear as if painted with an almost circumscribed spot of pure florid red; the feverish heat is augmented after eating, particularly solids, and on taking exercise; the burning heat in the palms of the hands and soles of the feet becomes more perceptible; there is difficulty of lying on one, more than the other side, wandering or fixed pains are felt in some part of the thorax, and the disease is accompanied with lassitude and asperity of the temper: the appetite becomes somewhat impaired, and there is frequently vomiting after eating. As the disease advances, the hectic fever is established, and the remissions become more distinct, attended with colliquative morning sweats; an exacerbation occurs about noon, and a slight remission happens about five in the afternoon: this is soon succeeded by another exacerbation, which gradually increases until after midnight, but after two o'clock in the morning, a second remission takes place, and is attended with more or less, sometimes profuse, sweating, which greatly debilitates the body; sometimes, however, the second exacerbation in the evening is not observed, but the exacerbation, which took place about the middle of the day, increases till evening, continues violent until the morning sweat breaks out, when the patient gets some unrefreshing sleep: the exacerbations are frequently attended with some degree of cold shivering, or more frequently only a sense of chilliness, or increased sensibility to cold is perceived, when to the thermometer the skin is preternaturally warm: the expectoration now becomes more viscid, copious, yellow, greenish, streaked with blood, disagreeable to the taste, and is discharged in small spherical masses, resembling pus, and is frequently also of an ash-colour; the cough abates in violence, but not in frequency, and is more distressing in the first part of the night, the breathing is short and quick, and the breath has an offensive smell; the pulse is frequent, full, and tense, or small and quick; the countenance now gives evident signs of wasting, the eyes lose their lustre and brilliancy, sink, grow dull and languid, the cheeks appear prominent, the nose sharp, the temples depressed, and the strength rapidly declines; this may be esteemed the second period: from the beginning the appetite is less affected than could be expected, the body is for the most part costive, particularly after the morning sweats have began to take place; the urine is generally high-coloured, and deposits a curdly pink sediment; about this period, in females, sometimes sooner, the menstrual discharge ceases, in consequence of the increasing debility. The third stage commences with a slight purging, which soon becomes a colliquative diarrhœa; when this takes place, the fever, heat, and morning sweats abate, but the cough continues distressing through the night; the tunica adnata becomes of a pearly white, the tongue appears clean, and with the fauces is of a bright red colour, sometimes covered with aphthæ, and generally sore and tender; the voice grows hoarse, and there is shortness of breath and hiccup, both of which distress the patient greatly; the lower extremities swell, and retain the impression of the finger. At this stage of the disease, sometimes sooner, the appetite is observed to become unnaturally keen, which deludes the unhappy sufferer and friends: as the disease advances, the diarrhœa becomes more violent, and sometimes alternates with the sweats, the strength rapidly decays, and memory and their affections forsake them; as the fatal period approaches, they have frequent and long faintings, the hairs fall off, the nails are incurvated; sometimes there are slight convulsions, and a few days before death, delirium comes on, and continues till that event takes place, or the senses remain entire, and the mind remains still confident and full of hope, till death steps in, and gently puts an end to their hopes and sufferings. As it is a matter of consequence to distinguish pus from mucus, we shall subjoin the following ingenious experiments of the late Mr. Charles Darwin:

1. Pus and mucus are both soluble in the sulphuric acid, though in very different proportions, pus being much the less soluble.
2. The addition of water to either of these compounds decomposes it; the mucus thus

separated, either swims on the mixture, or forms large flocci in it; whereas the pus falls to the bottom, and forms, on agitation, an uniform turbid mixture. 3. Pus is diffusible through a diluted sulphuric acid, though mucus is not; the same occurs with water, or a solution of the muriate of soda. 4. Nitrous acid dissolves both pus and mucus; water, added to the solution of pus, produces a precipitate, and the fluid above becomes clear and green, while water and the solution of mucus form a dirty-coloured fluid. 5. Alkaline lixivium dissolves (though sometimes with difficulty) mucus, and generally pus. 6. Water precipitates pus from such a solution, but does not mucus. 7. Where alkaline lixivium does not dissolve pus, it still distinguishes it from mucus, as it then prevents its diffusion through water. 8. Coagulable lymph is neither soluble in diluted, nor concentrated sulphuric acid. 9. Water produces no change on a solution of serum in alkaline lixivium, until after long standing, and then only a very slight sediment appears. 10. The muriate of mercury coagulates mucus, but does not pus. From the above experiments, it appears that strong sulphuric acid and water, diluted sulphuric acid, and caustic alkaline lixivium and water, will serve to distinguish pus from mucus; that the sulphuric acid can separate it from coagulable lymph, and alkaline lixivium from serum; and hence, when a person has any expectorated material, the composition of which he wishes to ascertain, let him dissolve it in sulphuric acid, and in caustic alkaline lixivium, and then add pure water to both solutions; and if there be a fair precipitation in each, he may be assured that some pus is present: if in neither a precipitation occur, it is a certain test that the material is entirely mucus: if the material cannot be made to dissolve in alkaline lixivium, by time and trituration, we have also reason to believe that it is pus. To the above ingenious experiments may be further added, the coagulation of pus by the muriate of ammonia, as observed by Mr. Home, and its globular appearance through the microscope; pus is also of the consistence of cream, of a whitish colour, and has a mawkish taste: it is inodorous when cold, and when warm it has a peculiar smell.

The predisposing *causes* are, hereditary disposition; mal-conformation of the chest; sanguine temperament; scrofulous diathesis which is indicated by a fine, clear, and smooth skin, large veins, delicate complexion, high-coloured lips, the upper one swollen, white and transparent teeth, light hair, and light blue eyes, with a dilated pupil; there is great sensibility, uncommon acuteness of the understanding, and a peculiar gentleness and softness in their manner; the immoderate use of venery; certain diseases, as the hooping-cough; siphilis, and various exanthemata, particularly the measles; various employments, as stonecutters, needle-grinders, flax-dressers, and all sedentary occupations, particularly those which require a considerable degree of stooping; the retrocession of eruptions; indulgence in intoxicating liquors, and, according to Dr. Beddoes, hyper-oxygenation of the blood. The exciting causes are, hæmoptysis; empyema; catarrh, particularly the influenza; asthma, obstructions of the abdominal viscera, particularly an enlarged and indurated state of the liver; calculi formed in the lungs; contagion and tubercles. The proximate cause is supposed to be an ulcer in the lungs.

The *prognosis* in this disease depends upon the causes whence it originates, and upon the violence of the symptoms: if it be in consequence of empyema or tubercles, there is more danger than when it arises from hæmoptysis or wounds in the chest, but every case of phthisis is always attended with danger; the progress of phthisis is often interrupted by pregnancy and mania, the latter has produced a radical cure, but in the former it almost always returns after delivery with increased violence.

In the *treatment* of this disease it will be particularly expedient to avoid, and if in our power, to remove the occasional causes mentioned above, by the proper methods, which are mentioned in other parts of this treatise; if several of the premonitory symptoms, as a dry, short, troublesome cough, occasional stitches in the sides, slight dyspnœa upon using exercise, and a pulse somewhat accelerated and hard, should attack a person of a phthisical habit, the most powerful remedies must be employed without loss of time; blood-letting, in a moderate quantity, will be necessary, and it should be repeated at proper intervals till those symptoms are relieved, taking care, however, not to reduce the strength of the patient too much, as debility is the most urgent symptom in the course of the disease: the bowels should be kept regular by gentle cathartics, as the calcined magnesia and rhubarb. After these evacuations, the [illegible]

cacuanha, either alone, or with a small quantity of emetic tartar, should be given in the morning fasting, in such doses as will excite vomiting once or twice at most; when the heat, fever, cough, and pain in the chest are considerable, small doses of the nitre, or the saline mixture, with nauseating doses of the emetic tartar, should be given three or four times in the course of the day: in this stage of the disease, small doses of calomel administered at bed-time, are of considerable service, except there is a tendency to diarrhœa, as the bowels, by its use, are not only kept regular, but it, at the same time, acts as a powerful deobstruent, and, in our opinion, an alterative course of mercury is of advantage, in the incipient stage of phthisis, for the removal of indolent tubercles: should the cough prove violent, opiates may be given at bed-time, and in the night, if necessary, the extractum papaveris albi, in doses of five grains or more, is particularly suitable; if there be a fixed pain in the breast or sides, increased upon coughing, local blood letting, and small blisters applied in succession about the thorax, will afford considerable relief, or a seton may be made as near the part affected as possible. In the second stage of the disease, the employment of emetics, composed of the ipecacuanha, with a few grains of the sulphate of zinc, must be duly persisted in, in the morning fasting: when the morning sweats are very profuse, the infusion of roses or vitriolic acid, should be employed with freedom; æther in the proportion of two or three drachms to a pint of water, with some of the mucilage of quince-seeds, makes a grateful and slightly tonic mixture, a glassful of which may be taken frequently, or the Bristol or Seltzer water may be drank; they are very efficacious in moderating the thirst, burning heat of the palms of the hands and soles of the feet, and the partial night sweats: opiates must be given in such doses as will quiet the cough and procure sleep, taking care, however, to obviate costiveness, and if the patient feel a sickness in the morning after them, coffee will effectually remove it; mucilaginous fluids, combined with small quantities of the spermaceti, are also of service in allaying the irritation in the fauces. When the inflammatory diathesis is subdued, chalybeates, combined with myrrh and carbonate of potash, may be given with advantage; lime-water is a suitable menstruum for dissolving the myrrh. The digitalis is strongly recommended in these two stages in particular, it certainly is deserving of a fair and impartial trial, and appears to be a medicine well suited to this disease, more especially in the inflammatory stage, from its well known power of rendering the action of the heart and arteries more slow than natural, a desideratum in phthisis, in which the pulse ranges from eighty to one hundred and twenty, or more; it also is very efficacious in exciting the action of the absorbents: the factitious airs may also prove an useful auxiliary, or air impregnated with the oxide of zinc, or manganese in their most comminuted state, might be applied to the lungs by means of an apparatus, as recommended by Dr. Darwin in his Zoonomia, or by that of Mr. Watt, of Birmingham: the vapour of a saturated tincture of æther, impregnated with hemlock, may be inhaled; it is made by macerating for a few days from one to two scruples of the dried leaves of the hemlock in an ounce of the æther. The hectic paroxysm may be prevented, or cut short, by the affusion of tepid water at the commencement of the hot stage, or its effects may always be moderated by moistening the palms of the hands and soles of the feet with vinegar or cold water; it should always be resorted to, when the burning heat mentioned above is present, it is not only perfectly safe, but highly refreshing. In the third stage, should the above plan not be adopted in time, and diarrhœa has made its appearance, the gentle emetics before mentioned are recommended to be administered, provided the strength of the patient is not too much exhausted, mild astringents should at the same time be employed, as the decoction of hartshorn, or logwood, angustura, columba, kino, and mucilaginous demulcent liquors, combined with opiates and absorbents. During the inflammatory period of phthisis, a vegetable diet, with milk, is indispensably requisite; souins, sago, barley, and rice, afford an agreeable variety; the lichen islandicus is strongly recommended, and is deserving of a trial; the ripe subacid fruits may be indulged in at pleasure, attention must, however, be paid to the state of the bowels: oysters, muscles, craw-fish, lobsters, and the testacea in general, also flounders and whitings, may be allowed occasionally, provided they do not disagree with the stomach, and do not aggravate the symptoms. In the advanced periods, when the hectic is completely formed, a small portion of animal

food may be taken for an early dinner, if it does not greatly increase the heat, and when the appetite becomes voracious, which it sometimes does towards the fatal termination, small quantities should be taken frequently: the drink, in almost every period of the disease, should consist of toast and water, Malvern water, milk and water, butter-milk, rice water, or the juice of ripe subacid fruits mixed with water, and occasionally lemonade. Wine, spirits, and fermented liquors of all kinds must be strictly prohibited, and the practice of mixing rum and other spirits with milk, cannot be too strongly reprobated; where, however, there is but little increased excitement, and the pain is inconsiderable, a more nourishing diet, and a moderate quantity of wine may be allowed, but the wine should be more or less diluted with water, and in the purulent stage, an invigorating diet always affords more or less relief. During the whole course of the disease, every irregularity and all crowded places must be studiously avoided. The patient should be advised to repair to Bristol in the early part of the disease, and should make use of such exercise as his strength will bear, as swinging, gestation in a carriage, or riding on horse-back in progressive journeys, or the alternation of this last exercise, and gestation in a carriage, but a sea voyage is the most effectual of all kinds of gestation; the patient must by all means avoid the piercing north-east winds in this country, it will therefore be advisable for him to visit a temperate southern climate during the winter and spring: the patient should be advised to lie on a hair mattrass, with slight coverings over his body, and should be earnestly requested to go to bed early, and to get up soon in the morning, even if obliged, through debility, to lie down in the course of the day: the feet should be kept dry and warm, and the patient should wear flannel or cotton next to his skin, the former, however, is far more salutary; in the florid consumption, an elevated and inland air is often of the most essential service. Should we be so fortunate as to subdue the too fatal disease by the means recommended above, it will be indispensably requisite for the patient to persevere in employing the regimen recommended in the treatment of this complaint, for a considerable length of time after every symptom of the disease has disappeared, and he must return to his former manner of living with the utmost caution; the diet should, however, be light and nourishing, and in moderate quantity: the patient should breathe a pure dry air, and should take such exercise, particularly on horse-back, as he can bear without fatigue, and should use the warm bath; and when the constitution can be brought to bear it, he may employ the cold bath or sea bathing.

Order V. *Profluvia.* Insanguineous Fluxes.

These are ordinally characterised, as consisting of pyrexy with an increased secretion, naturally void of blood. The genera are two: 1. Catarrhus, Catarrh. 2. Dysenteria, Dysentery. This order might easily be suppressed, and the genera it comprises transferred to other situations to which they more properly belong, even under the present nosology. Catarrh is described as possessing pyrexy, frequently contagious; an increased secretion of mucus, or at least efforts to excrete it. Dysentery, as evincing contagious pyrexy, frequent mucus or bloody stools, while the alvine feces are for the most part retained, gripes, tenesmus.

Catarrh will be distinguished from the measles by the greater mildness of the febrile symptoms, by the state of the eyes, by the absence of coma, and many of the symptoms accompanying the eruptive fever of measles.

This disease is rarely attended with danger, except there be great difficulty of breathing, attended with a livid and bloated countenance, or it has been treated with negligence or impropriety, in which case it often passes into pneumonic inflammation, attended with symptoms of the utmost danger; in general, however, it is a slight and safe disease, unless it attack persons of a phthisical habit, or those advanced in life; in the former it may occasion phthisis, and in the latter, peripneumonia notha.

For its *cure*, nothing more is requisite, in general, than abstinence from animal food for a few days, keeping the body warm, and drinking freely of tepid mucilaginous diluents; if there be, however, a considerable degree of excitement, blood-letting will be necessary, but it must be employed with some degree of caution, as it is frequently succeeded by depression of strength, particularly when catarrh is epidemic. If there be much oppression and tightness about the chest, occasioning a degree of dyspnœa, local blood-letting will be advisable, and blisters must be applied to the

sternum and scrobiculus cordis; gentle laxatives should be ordered; the patient should take copious draughts of some mucilaginous acidulated liquids; a gentle diaphoresis should be promoted by nauseating doses of tartar emetic, with spirit of mindererus, or by exhibiting the volatile alkali in wine whey; the vapour of warm water, impregnated with vinegar, should be frequently inhaled; mucilaginous oily demulcents should be given, and expectoration should be promoted by the means pointed out when treating of pneumonic inflammation. If the cough remain troublesome, after we have subdued the inflammatory diathesis, opiates, combined with the tartar emetic, or with ipecacuanha, may be employed with safety and advantage; rubbing the nose externally with oil, some ointment, or, with what is most commonly employed, warm tallow, is very often of great service, when the mucous membrane of the nose is much affected, which practice has very frequently come under my observation. In the treatment of the epidemic catarrh (influenza), as being frequently attended with a considerable degree of debility, the antiphlogistic regimen must not be pushed too far, even though there may be some appearance of excitement: it will, in general, if blood-letting should be deemed necessary, be more advisable rather to trust to local than to general blood-letting, blisters, mild diaphoretics, and diluents; sometimes, however, a more liberal diet, and the moderate use of wine, will answer better. Might not the affusion of tepid, or even cold water, be employed with safety, if the heat of the surface be greater than natural, and there be at the same time no tendency to asthma or phthisis pulmonalis?

Dysentery is most commonly preceded by costiveness, unusual flatulence, acid eructations, and wandering pains in the bowels; in most cases, however, from the commencement, griping pains are felt in the lower part of the abdomen, which often arise to a considerable degree of severity; the bowels are irritated to frequent evacuation, in indulging which, but little is voided, and the rectum often becomes exquisitely painful and tender; the matter evacuated is often very fœtid, and the stools are frequently composed of mucus, pus, blood, membranous films, and white lumps of a sebaceous nature, the mucus is generally mixed with a watery fluid, and is often frothy: tenesmus, in a greater or less degree, generally accompanies the evacuation of the bowels, and it very rarely happens that the natural fæces appear during the whole course of the disease, and when they do, they are in the form of scybalæ, that is, small separate balls, which appear to have lain long in the cells of the colon; when these are voided, either by the efforts of nature, or as solicited by medicine, they procure a remission of all the symptoms, more especially of the frequent stools, griping, and tenesmus; with these symptoms there is loss of appetite, great anxiety about the præcordia, frequent sickness, nausea, vomiting, and the matter rejected is frequently bilious, watchfulness, and prostration of strength: there is always some degree of symptomatic fever, which is sometimes of the remittent or intermittent type; sometimes it assumes the synochous, and very frequently the typhous type: the tongue is white, and covered with tough mucus, or rough, dry, and sometimes black; the patient complains of a bitter taste in the mouth, and in the advanced stage of the disease there is hiccup, and aphthæ. If the small intestines only be affected, the pain is described to be most acute and excruciating about the umbilicus, the bowels are not evacuated immediately after the griping pains, the blood is mixed intimately with the fæces, and the sickness, vomiting, and pain at the stomach, are more urgent. If the large intestines be the seat of the disease, the pain is more obtuse, not so constant, is more distant from the umbilicus, and is more immediately followed by stools, and the purulent matter of blood, if there be any, is less mixed with the rest of the excrements, or only floats upon them, and there is more sickness than griping; but it frequently happens, that both the large and small intestines are affected, which renders it very difficult to determine, with any certainty, the seat of the disease. The remote causes are, cold alternating with heat, derangement of the primæ viæ, and contagion. The proximate cause is supposed to be a preternatural constriction of the intestines, more particularly of the colon. This disease will be readily distinguished from diarrhœa, by the absence, or less degree of fever in the latter; the less degree of griping and tenesmus, the appearance of the stools, and the other symptoms in diarrhœa will further assist us.

Treatment. When the patient is of a robust and plethoric habit, and the disease

is attended with acute pain in the bowels, with a strong full pulse, blood-letting will be necessary, but it must be practised with caution, especially in warm climates, where the employment of powerful antiphlogistic measures is often succeeded by a sudden and dangerous degree of debility; gentle emetics should be administered, they are not only useful in emptying the primæ viæ, but they also determine to the skin; they will be more efficacious when given in such small and repeated doses, as not to excite immediate vomiting, unless the oppression at the stomach is urgent; the emetics generally employed in dysentery are ipecacuanha and tartar emetic, and, at the early periods of the disease, they will be more efficacious when combined: the morbid and noxious contents of the intestines, the most pernicious source of irritation in dysentery, must be expelled by cathartics, those most generally celebrated are, the ipecacuanha and tartar emetic, the former is, however, most frequently employed, it may be given either alone, or in combination with the crystals of tartar, in such doses as will produce some degree of nausea, and repeated when the nausea abates; the calomel is an excellent remedy where there is a tendency to inflammation, but it should never be given alone, its operation is rendered both more easy and certain, by combining it with other cathartics; the most effectual remedy, however, in general, is a simple solution of Epsom salts, or Glauber's, or it may be given in a diluted infusion of senna, with a considerable proportion of manna; the cream of tartar with tamarinds, the phosphate of soda, and castor oil, will make an useful variety; after the operation of the cathartic is finished, it will be advisable to administer opiates, and they will be more efficacious if given with nauseating doses of emetics; the pulvis ipecacuanhæ compositus is a good medicine; the hyoscyamus, by its anodyne and gently laxative qualities, seems eminently adapted to this disease. The warm bath is often used with advantage; fomentation of the abdomen is more frequently serviceable, but the most effectual remedy is a large blister applied over the abdomen; in mild cases, however, so severe a remedy is not necessary; the addition of strong peppers to the fomentations, may, in such cases, answer our intentions: the pain attending the tenesmus will be allayed by fomenting the anus with hot water, or with an decoction of chamomile flowers, with some tinctura opii sprinkled on the stupes: stranguary is not an uncommon symptom, independent of cantharides, it will be effectually relieved by fomenting the pubes and perinæum: mucilaginous demulcent liquids must be given freely, for the purpose of defending the intestines against the acrimony of their contents, and mucilaginous, and oily clysters should be employed once or twice a day, or more, they are very serviceable for the same intention as the mucilaginous liquids, and act also as a fomentation; they should consist of a strong decoction of linseed or starch, or they may be composed of milk and oil, united by means of mucilage. In the advanced and chronic stage of the disease, as acidity of the stomach chiefly prevails at that period, absorbents will be useful, as the mistura cretacea, aqua calcis, pulvis cretæ compositus, &c. combined with opiates; astringents will also, at this period of the disease, be proper, as the kino, hæmatoxylum, catechu, &c. and if the powers of the stomach be much weakened, they may be combined with chalybeates. The tone of the bowels will be restored, by administering quassia, bark, angustura, or colombo; an infusion of gentian and cinnamon in port wine is recommended; it will always be advisable to join aromatics with bitters: a purgative of the calomel and rhubarb should be given from time to time in this form of the disease, and when it remains obstinate, we may always suspect visceral obstruction; should this, upon examination, be the case, mercury, either internally, or by friction, should be employed until some sensible effect is produced in the mouth. The diet in the first stage should consist of milk, sago, panada, salep, Indian arrow-root (maranta arundinacea), and rice, the quantity being regulated by the appetite; the sweet and subacid fruits may be allowed, and they are particularly serviceable when there is much bile in the primæ viæ. In the more advanced stages, the ripe fruits are condemned, but it does not, however, appear, on sufficient grounds, that they should be so; together with the farinacea, a small quantity of animal food may be allowed in the chronic state of the disease, provided it does not disagree with the patient. The drink at the commencement should be either barley or rice water, boiling water poured upon toasted bread, or burnt biscuit, whey, or the decoction of hartshorn, and the like; in the advanced stage of the disease, Port Wine or Madeira,

or a moderate quantity of spirits diluted with water, will be proper; the patient should wear flannel next to the skin for some time after the disease is gone off, and should take as much exercise as he can bear without fatigue, either on horse-back or in a carriage, carefully avoiding exposure to cold or moisture. The powder, or extract of nux vomica, is strongly recommended by Dr. Hufeland, in doses of from six to ten grains of the powder, three times a day; or one or two grains of the extract may be given every two or three hours; three or four grains or more may be given in clysters: children of one year old may take from one to two grains of the extract in the twenty four hours; it is necessary to observe, that the medicine is directed to be administered in some mucilaginous mixture. It is of consequence to warn the young practitioner, in the most forcible manner, against employing opiates at the beginning of this disease, unless a free evacuation of the bowels has been procured by cathartics, and the excitement much diminished, as they generally aggravate the disease; and it will always be pernicious to give them without nauseating doses of emetics, while the griping pains remain; the hyoscyamus, if anodynes be deemed requisite, is preferable to opium, in consequence of its possessing a gently laxative quality.

CLASS II. NEUROSES.

This class of diseases is characterised by an injury of the sense and motion, with an idiopathic pyrexy, or some local affection. It comprises the following orders:

ORDER I. *Comata.* STUPORS.

Implying a diminution of voluntary motion with sleep, or insensibility, and including the following genera: 1. Apoplexia, apoplexy, which is either idiopathic or symptomatic, and is described thus: almost all voluntary motion diminished, with sleep more or less profound; the motion of the heart and arteries remaining. 2. Paralysis, palsy, only some of the voluntary motions diminished, frequently with sleep. These also are either idiopathica or symptomatic; the species are asthenic, paralytic, convulsive.

Of *apoplexy*, the symptoms are so well known, that they need not to be repeated. Dr. Bailey remarks very justly, that "when the patient is not cut off at once, but lives for some time after the attack, the hemiplegia, which is almost constantly an effect of this disease, is upon the opposite side of the body from that of the brain, in which the effusion of blood has taken place: this, the learned author observes, would seem to shew, that the right side of the body derives its nervous influence from the left side of the brain, and the left side of the body, its nervous influence from the right side of the brain." This disease is observed to make its attacks most frequently about the period of the equinoxes.

The predisposing *causes* are, a declension from the meridian of life, a large head, a short neck, the sanguine or phlegmatic temperament, obesity, an indolent life, or one too much devoted to study, too long sleeping, high living, indulgence in spirituous liquors, the gout, and the suppression or cessation of the hæmorrhoidal, or any other habitual hæmorrhage or evacuation. The exciting causes are, violent exercise, as dancing after too great repletion of the stomach, a full and long continued inspiration, too strong exertions of the mind, every passion which agitates the human frame, great external heat, especially from a crowded room, intemperance, warm bathing, crudities in the primæ viæ, violent emetics, the spring season, rapid alternations of heat and cold, too great indulgence in smoking tobacco, long stooping with the head down, tight ligatures about the neck, over distention of the blood vessels of the brain or its membranes, an effusion or extravasation of blood or serum into the substance of the brain or its ventricles, fractures of the scull or depression of it, causing an effusion of blood upon the brain or its meninges, and tumors within the cranium. The proximate cause is supposed to be whatever interrupts the motion of the nervous power from the brain to the muscles of voluntary motion. Difficulty of swallowing, and the regurgitation of the drink through the nostrils, great difficulty of breathing, and foaming at the mouth, are symptoms of the most imminent danger, but the prognosis may be generally collected from the violence of the attack, profoundness of the sleep, stertorous breathing and the degree of the affection of the respiration, and of the powers of sense and of motion: the first attack of this disease is not commonly fatal, particularly if the patient be not cut off in the course of the first week; it frequently terminates favourably either by diarrhœa, hæmorrhage, return of the hæmorrhoidal, or any other habitual discharge, and sometimes by the appearance of fever.

Treatment. As this disease arises in consequence of an effusion of blood or serum into the ventricles of the brain, or upon its meninges, blood-letting in a moderate degree may be of service, but copious bleedings must be injurious, by weakening the patient, and preventing the absorption of the effused fluid; the blood should be taken from the temporal artery, or the jugular vein, and if that cannot conveniently be done, it may be taken from the arm; if one side be more affected than the other, the blood should be taken from the side least affected; cupping the occiput is often serviceable, and it does not reduce the patient's strength so much as general blood-letting; warm fomentations of the shaved head continued for a length of time, and frequently repeated, will be of service; an emetic is recommended to be administered, but, in our opinion, it is at least a doubtful remedy, unless the patient is affected with nausea in consequence of repletion of the stomach; acrid cathartics, as aloes, resin of jalap, calomel, combined with the scammony, or with the extract of colocynth, &c. should be given by the mouth, if the power of swallowing remains; and clysters, composed of a solution of some of the above cathartics, and the oleum succini, should be injected; blisters should be applied to the head, spine, and extremities, or a large caustic should be applied to the neck, and mustard cataplasms to the feet: the patient should be kept cool, and as much in an erect posture as he can bear without inconvenience; small electric shocks should be sent through the head; errhines and acrid volatile medicines are recommended, but to us they appear at least doubtful remedies: if the disease appear to be the consequence of the suppression of the hæmorrhois, leeches should be applied to the hæmorrhoidal veins, fomentations must be employed, and the intestines must be stimulated by means of aloetic cathartics. The strength of the system will be restored by bark, bitters, and chalybeates. The return of this disease is to be prevented by studiously avoiding all the remote causes which are in our power; a plethoric state of the blood vessels of the brain must be obviated by a low diet, abstinence from fermented or spirituous liquors, moderate exercise, as riding on horse-back, if not affected with frequent fits of giddiness, or by walking; costiveness must be prevented by gentle cathartics, and if the disease had arisen from the suppression of the hæmorrhoidal flux, aloetic purgatives will be most suitable; an issue or seton should be made as near as possible to the head, or, as being less disagreeable, a thin slice of the fresh root of the daphne mezereum, steeped in vinegar for twenty-four hours, may be applied daily, and if the inflammation should be very considerable and the discharge profuse, it may be left off for a few days, and the parts should be kept moistened with a solution of sugar of lead.

In *palsy* many of the symptoms have a resemblance to those of apoplexy; it will be distinguished from apoplexy, however, by the pulse, which, in this disease, is slow and soft, and by the other symptoms. If it arise from the causes producing apoplexy, it must necessarily be treated in the manner just recommended. When the apoplectic symptoms are removed, and hemiplegia or paralysis only remains, or when it arises from diminished energy of the nervous system, it will be proper to prescribe internal and external stimulants; of the former class are, white mustard seeds, slightly bruised or swallowed whole, in the quantity of a large table-spoonful, three or four times a day, or horse-radish scraped, a table-spoonful of which may be swallowed without chewing, night and morning, or they may be combined and made into an infusion, by macerating two ounces of each in a quart of boiling water for four hours, and adding two ounces of the spirit of pimento to the strained liquor, of which two or three ounces may be given three or four times a day; the arnica montana is strongly recommended; the volatile alkali is often of service, and sumach is deserving a trial, from half a grain to three or four grains or more of the dried leaves are directed to be given two or three times a day: of the latter class of stimulants are, blisters, friction of the parts affected with mustard, æther, volatile alkali, linimentum ammoniæ fortius, or the oleum terebinthinæ, combined with the oleum succini and tincture of cantharides; stinging with nettles and electricity, both sparks and shocks will be of considerable service, particularly if employed early in the disease; flannel must be worn next the skin, warm sea-bathing, and friction with flannel or the flesh-brush, will be useful auxiliaries. If the disease appear to have arisen in consequence of intemperance, the liver will most probably be found to be more or less in a diseased state, which will be known by referring to

the diagnostic remarks, in the article DIETETICS, in which case, some of the preparations of mercury may be given with much advantage, employing afterwards bitters, bark, and chalybeates: the diet should be light, nourishing, and stimulating. The Bath waters are very serviceable, both by the mouth, and as a bath; particularly so if the disease have arisen from intemperance, or the colica pictonum; should there, however, be a constitutional determination to the head, we must strictly attend to the effects, which the Bath waters produce upon the system, as they may suddenly induce much mischief.

ORDER II. *Adynamiæ*, DEFECTIVE POWER.

This title is inexplicit, as being equally applicable to a variety of other orders as well as to the present. The order is characterised thus: a diminution of the involuntary motions, whether vital or natural.

The genera are: 1. Syncope, or fainting; a diminution, or for a short time, a total stoppage, of the motion of the heart. It is either idiopathic, or symptomatic. 2. Dyspepsia, or indigestion; anorexy, nausea, vomiting, inflation, belching, rumination, heart-burn, pain in the stomach; these, or some of these symptoms at least concurring, for the most part, with a constipation of the belly, and without any other disease either of the stomach itself or of any other parts. 3. Hypocondriasis, indigestion with langour, sadness and fear without any adequate causes in a melancholy temperament. 4. Chlorosis, green-sickness, or a desire of something not used as food, a pale or discoloured complexion, the veins not well filled, a soft tumour of the whole body, debility, palpitation, suppression of menstruation.

It is obvious that the genera of this order relate, for the most part, either to those which belong naturally to the tribe of diseases of indigestion, and have already been treated by us under the article DIETETICS, or else are catenated with peculiar states of the female frame, and as such fall naturally into the article MIDWIFERY, and will be noticed under that term.

ORDER III. *Spasmi.* SPASMS.

Irregular motions of the muscles or muscular fibres. This definition, however, does not sufficiently distinguish this order from some of the species of syncope, which ranges under the last. It is a very numerous family, divided into two sections.

A. In the animal functions: 1. Tetanus, a spastic cramp or rigidity of almost the whole body, varying according to the remote cause, as it arises either from something internal, from cold, or from a wound, or according to the part of the body affected, be the cause what it may. 2. Trismus, a spastic rigidity of the lower jaw; two species, the first seizing infants, the second seizing persons of all ages from a wound or cold. 3. Convulsio, convulsions, commonly so called, an irregular chronic contraction of the muscles without sleep; idiopathic, and symptomatic. 4. Chorea, St. Vitus's dance, attacking those who have not yet arrived at puberty, most commonly within the tenth and fourteenth year of age, with convulsive motions for the most part in attempting the voluntary motion of the hands and arms, resembling the gesticulations of mountebanks; in walking, appearing to drag rather than to lift one of the feet after the body. 5. Raphania, a spastic contraction of the joints with a convulsive agitation, and most violent periodical pain. 6. Epilepsia, epilepsy, a convulsion of the muscles with sleep, from various causes, and of various species; cerebral, sympathetic, occasional, as proceeding from injuries of the head, pain, worms, poison; from repulsion of the itch, or an affusion of any other acrid humour, from crudities in the stomach, from passions of the mind, from an immoderate hæmorrhage, or from debility. 7. Palpitatio, palpitation, a violent and irregular motion of the heart. 8. Asthma, a difficulty of breathing returning by intervals, with a sense of strictness in the breast, and a noisy respiration with hissing. In the beginning of the paroxysm no cough, or the coughing difficult, but the cough free towards the close, frequently with a copious spitting of mucus: three species, spontaneous, from eruptive fevers, from plethora. 9. Dyspnœa, impeded respiration, a continual difficulty of breathing, without any sense of straitness, but rather of fullness and infarction in the breast; a frequent cough throughout the whole course of the disease; eight idiopathic species; three symptomatic, accompanying diseases of the heart; a swelling in the abdomen, producing various maladies. 10. Pertussis, hooping cough, a contagious disease; convulsive strangulating cough, reiterated with noisy inspiration; frequent vomiting. 11. Pyrosis,

water-brash; a burning pain in the epigastrium, with plenty of aqueous humour, for the most part insipid, but sometimes acrid, belched up. 12. Colica, colic, pain of the belly, especially twisting round the navel, vomiting, constipation. Numerous species, varying according to the nature of the remote cause, and hence proceeding, *a*, from metallic poisons; *b*, from acids taken inwardly; *c*, from cold; *d*, from a contusion of the back; *e*, from costive habit; *f*, from retained meconium. 13. Cholera, Iliac passion; a vomiting of bilious matter, and frequent excretion of it by stool; anxiety, gripes, spasms in the calves of the legs. Two species, the one arising in a warm season without any manifest cause; the other from acrid matters taken inwardly. 14. Diarrhœa, looseness, frequent stools: the disease not infectious; no primary pyrexy. The species are, crapulous, or from excess of eating; bilious; mucous; cœliac, discharging a chyle like secretion; lienteric, in which the aliments are discharged with little or no change; atrabiliary. Of these several have been already noticed in the article DIETETICS. 15. Diabetes, a chronical profusion of urine, for the most part preternatural, and in immoderate quantity. Two species, D. mellitus, with urine of the smell, colour and taste of honey; D. insipidus, limpid, but not sweet urine. 16. Hysteria, hysterics, rumbling of the bowels, a sensation as of a globe turning itself in the belly, ascending to the stomach and fauces, and then threatening suffocation; sleep; convulsions; a large flow of limpid urine; the mind involuntarily mutable and fickle. Almost all the varieties of this disease proceed from irregularity in the female sexual organs, and will be found described under the article MIDWIFERY. 17. Hydrophobia, a dislike and horror at any kind of drink, as occasioning a convulsion of the pharynx, induced for the most part by the bite of a mad animal. The species are, rabid hydrophobia, from the bite of a mad animal, the desire to bite being propagated; and simple hydrophobia, without madness, or any desire of biting. This genus is equally misnamed, misplaced, and misdescribed.

We can only offer a few observations upon such of this family of diseases as are of most importance from their danger or frequency of appearance.

Tetanus, trismus, Locked-jaw. The two species denominated by these names, are in reality the same disease, varying only in extent. Tetanus sometimes comes on suddenly, more generally, however, a sense of stiffness, or slight twitchings, are first perceived in the neck, these gradually increasing, the motion of the head becomes difficult and painful; as the rigidity of the neck becomes more considerable, a sense of uneasiness is felt about the root of the tongue, which, by degrees, produces a difficulty, or inability of swallowing; there is violent pain under the ensiform cartilage, which shoots to the back; when this pain arises, the muscles, particularly of the back part of the neck, are immediately affected with spasm, pulling the head strongly backwards, at the same time the muscles of the lower jaw become rigidly contracted, so that the teeth are firmly closed together; as the disease advances, the muscles of the whole spine are affected, and draw the body backwards, producing opisthotonos; at other times the muscles of the fore part of the body are affected, and emprosthotonos is the consequence; and when the antagonist muscles of the whole body are so contracted, that the patient can bend himself in no direction, but remains as stiff as the trunk of a tree, the disease is called tetanus, which is, however, not so common a form of it, as the one we are now giving a description of; the abdominal muscles become violently affected with spasm, so that the belly is strongly retracted; at length the whole of the muscles of the head, trunk, and extremities, become strongly affected, and the body is rigidly extended, as above described; the tongue is often partially attacked with spasm, and is often thrust out violently between the teeth; at the height of the disease, every organ of voluntary motion suffers, in a greater or less degree, and in particular the muscles of the face; the forehead is drawn up into furrows, the eyes are hollow, distorted, rigid, and immoveable, the nose is drawn upwards, and the cheeks are drawn backwards towards the ears, so that the whole countenance expresses a most ghastly appearance, and in this state, violent convulsions supervene, and put an end to life. The spasms are attended with violent pain, and generally last for a minute or two, and as the disease advances, they are often renewed every quarter of an hour, and sometimes terminate in general convulsions; there is seldom any fever, but when the spasms are violent, the pulse is contracted, hurried, and irregular, and the respiration is alike affected, and there is sometimes an interruption

of the breathing and convulsive hiccup; in the remissions, the pulse and respiration are natural, the heat of the body is commonly not increased, the face is generally pale, with a cold sweat upon it; the extremities are generally cold, and there is frequently a cold sweat over the whole body, sometimes, however, when the spasms are very frequent and violent, the pulse becomes full and frequent, the face is flushed, and a warm sweat is diffused over the whole body: it is a very remarkable circumstance that neither the mental nor natural functions are considerably affected, there is seldom delirium, or confusion of thought, the appetite remains good, the urine is sometimes suppressed, or is voided with difficulty and pain, and there is costiveness. It is remarked by Dr. Blane, that the convulsive twitchings are sometimes even accompanied with pleasure.

This disease often proves fatal before the fourth day; after that period there is generally less danger, but, although there may be some abatement of its violence, it is apt to return with renovated force; a favourable termination of it is sometimes attended with a sensation of stupor, or formicatio, and a sense of itching; more frequently, however, it goes off, without any evident crisis; the danger will, therefore, be determined by the violence of the attack, and frequent recurrence of the spasms and general convulsions.

The *removal* of this disease must be attempted by administering opium in moderate but frequent doses, and where the deglutition is performed with any difficulty, it should be thrown in by clyster; wine is a most valuable auxiliary, but it should be taken in large quantities, and it will be more serviceable when given in combination with opium; bark is recommended, but it does not appear to have answered the sanguine expectations that were to be wished for; mercury is often of service, provided it is pushed so far as to affect the mouth; the warm bath, or a bath composed of milk or oil, has been recommended, and has sometimes succeeded, when employed in combination with opium, the heat of the bath is ordered to be lowered or raised, so as to afford the sensation of gentle and comfortable warmth; the most powerful remedy, however, appears to be immersion in the cold bath, in the paroxysm of convulsion, taking care to have some warm blankets in readiness, and immediately the patient is taken out of the bath, he should be well rubbed with warm flannels, and put to bed; opiate frictions are particularly recommended, as the medicine can, in this way, be introduced into the system more readily, and without increasing the frequency of the spasms, which frequently occur during the efforts of deglutition; the combination of opium with æther is also of great service; the diet should consist of milk and broths, and if the nourishment cannot be received by the mouth, it should be thrown up by clyster. If the disease have arisen in consequence of the partial division of a nerve, it should be cut through; and if from a wound, it should be dilated, and filled with stimulating applications; as lint, moistened with the oleum terebinthinæ, and we must avoid exposure of the part to a current of cold air: the pain under the ensiform cartilage, and the spasms in general, will most commonly be relieved by applying cloths dipped in æther, and by gentle and uniform pressure on the parts suffering from spasm, by means of bandages, on which the æther should be poured occasionally, guarding, however, against the cold produced by the too speedy evaporation of the æther. The trismus of infants is a disease most frequent in warm climates, it generally attacks infants, within the first fortnight after birth, more generally, however, before they are nine days old; as it, in our opinion, very frequently proceeds from a retention of the meconium in the primæ viæ, it will be highly proper, in the first instance, to exhibit gentle laxatives, afterwards wine and antispasmodics, and if we do not succeed by these means, it will be advisable to try the cold bath, and the remedies above recommended.

Epilepsy may be distinguished from other species of convulsions by the sopor, and by the abolition of the sensation of external impressions; from apoplexy, by the increased action of the muscles: from hysteria, by the absence of the globus hystericus, and by its not being attended with the fear of death. The symptomatic epilepsy is more easily cured than the idiopathic; the later in life epileptic fits are experienced, the more dangerous they may, in general, be esteemed, as the cause may be supposed to have been acquired by the patient's habits of life, or by the decay of some internal part: hereditary epilepsy is scarcely ever cured; the longer the continuance of the complaint has been, and the more violent and frequent the convulsions are, the more

dangerous is the disease, particularly if the vital functions be much affected; sometimes, although not very frequently, a single violent paroxysm cuts off the patient: epilepsy sometimes goes off at the age of puberty, or on the appearance of the menses; an intermittent fever, or a cutaneous eruption often removes the disease.

Treatment. Blood-letting will sometimes be of service in the paroxysm, if the disease has not been of long continuance, and the patient is in a plethoric state; in general, however, it is more advisable not to take away blood, but to trust to less debilitating remedies; immediately the patient is attacked with a fit, we must endeavour, as far as possible, to prevent his receiving any injury from the violent agitation of his body, he ought, therefore, to be put into a bed, with his head raised, and to have any pressure, occasioned by ligatures about his neck, instantly removed; stimulants should be applied to the nostrils, as errhines, or volatiles, as the spiritus ammoniæ compositus, the spiritus ammoniæ succinatus, &c. and the spine should be rubbed with the æther, or with the linimentum ammoniæ fortius, or oil of turpentine, and they will be more serviceable, if combined with stimulants, as the oil of amber, or the tincture of cantharides; it will be proper to administer opiates, and other anti-spasmodics, by clyster, particularly musk, and valerian. In the intermissions we are to attempt the radical cure of the disease; when the disease is symptomatic of some primary affection, we must, by a particular attention to the attending symptoms, endeavour to discover the nature of that affection; and if we succeed in removing the primary affection, by the proper means adapted to its cause, the epileptic attacks will cease of course; the aura epileptica has been removed by a tight bandage being made round the limb, just above the part from which that sensation appears to proceed; we must direct the patient to carefully avoid the occasional causes which are within his reach, and the predisposition must be corrected, as far as lies in our power. When the disease is idiopathic, and appears to depend upon a plethoric state of the system, that must be removed or prevented by moderate exercise, an abstemious diet, and issues, or setons, if the disease appear to arise from any suppressed discharge, in particular the hæmorrhois, leeches should be applied to the hæmorrhoidal vessels, fomentations should be employed, and we should, at the same time, administer aloetic cathartics; after the plethoric state of the system is removed, the cure of the disease will be effected by antispasmodics: when the disease seems to arise in consequence of a debilitated state of the system, it must be strengthened by cold-bathing, exercise, change of air, a nourishing diet, tonics, and anti-spasmodics; the most suitable tonics are, bark, oxide of arsenic, ammoniate of copper, sulphate of copper, oxide of zinc and chalybeates: the antispasmodics in most general use are, oil of cajeput (melaleuca leucadendron), æther, musk, digitalis, stramonium, belladonna or hyoscyamus, lunar caustic and opium, which last is most assuredly the best and most efficacious antispasmodic, it should be administered in doses, proportioned to the age and constitution of the patient, a short time before the expected return of the paroxysm, the opium must be repeated at proper intervals, and it will be necessary to increase the dose in a gradual manner, in proportion to the violence or frequent recurrence of the fits: whatever antispasmodic is employed, it will be indispensably requisite never to allow its effects to cease on the system, and to continue its use for months, or even a year or two after the violence of the disease is overcome, and the fits have ceased, in order to establish a new habit in the system, and it should, on no account, be left off all at once, but the dose should be gradually diminished, as the fits are very apt to return, on the discontinuance of the medicine, with increased violence and danger: it will not be improper to remark, that antispasmodics are employed with most advantage, a short time previous to the expected recurrence of the paroxysm, and when the fits recur during sleep, a full dose of an opiate should be given at bed-time; the application of a cataplasm, formed chiefly of tobacco, to the scrobiculus cordis, about half an hour before the expected return of the paroxysm, has sometimes prevented it, and this practice, repeated several successive days, at the expected periods, has destroyed the diseased catenation, and effected a permanent cure: if the disease appears to arise from sympathy, some instrument of terror should be kept in readiness, as the actual cautery, or something that will inspire horror, which will very frequently prevent the fits: should derangement of the primæ viæ, worms, dentition, or any other obvious exciting cause, be the means of occasioning the disease, it must be re-

moved by laxatives, and other remedies adapted to its causes, and as the disease so frequently, in part, arises from the first mentioned cause, occasional emetics and gentle cathartics will be proper, in order to obviate any accumulation of irritating matter in the stomach and intestines: when the disease proves obstinate, especially in those who are advanced in life, or have been intemperate in the use of fermented, spirituous, or distilled liquors, we have every reason to suspect some derangement in the hepatic system; in which case it will be requisite to employ the hydrargyrus, to a greater or less extent, in proportion to its effects on the disease, and it will, if the patient is not in a very debilitated state, sometimes be of essential service to push mercury so far as to affect the mouth. A total change of habit and climate may also frequently be prescribed with great benefit.

Asthma. The paroxysms of this disease very frequently commence during or after the first sleep, with a sense of tightness and stricture across the chest, and a feeling of uneasy oppression in the lungs, impeding respiration; there is either no cough present, or it is not attended with any expectoration: the patient, if in a horizontal situation, is immediately under the necessity of getting into an erect posture, and of flying for relief to the open window; the difficulty of breathing for a time increases, and both inspiration and expiration are attended with a wheezing noise, the voice is weak, and the exertion of talking is more or less painful: after these symptoms have continued for some hours, a profuse sweat sometimes breaks out, the breathing becomes less laborious, and the cough, which, at the commencement, was not present, or was without any expectoration, now becomes more free, and a more or less copious secretion of mucus takes place, and the other symptoms abate, but there is a greater or less degree of tightness across the chest, and of difficulty of breathing, throughout the course of the day; towards evening, or about midnight, for several successive nights, the symptoms suffer an exacerbation, and a remission takes place towards morning; and after some days, on the expectoration becoming and continuing more copious, the paroxysms for a time cease altogether: the pulse is, for the most part, quick, weak, and small; and the urine, which, at the commencement of the paroxysm, was pale, in its remission becomes high-coloured, and often deposits a sediment; the face is sometimes, during the paroxysm, somewhat flushed and turgid, more commonly, however, it is pale and shrunk: asthma is very frequently an hereditary disease, it does not very commonly appear before the time of puberty, and chiefly affects the male sex; it is most liable to return in hot weather, this, however, is not always the case: the paroxysm is often preceded by lassitude, torpor, drowsiness, a sense of weight or pain of the head, and symptoms of dyspepsia.

Treatment. In the paroxysm, if the patient be young, and of a plethoric habit, blood-letting will be often of service, especially, if employed in the early periods of the disease, but if it have been of long continuance, it is generally hurtful, but cupping between the shoulders is often of considerable service; gentle laxatives and clysters should be employed, at proper intervals, so as to keep the bowels regular; gentle emetics should on no account be dispensed with, and where a paroxysm is expected to occur in the course of the night, an emetic exhibited in the evening will generally prevent it: antispasmodics should be administered, as opium, asafœtida, æther, &c.; it will be necessary to assist and promote the expectoration by means of some of the following remedies, either alone, or perhaps a more preferable manner will be in combination, as milk of ammoniac or of asafœtida, the decoction of senecka, or a solution of spermaceti, with nauseating doses of tartar emetic, or with some of the preparations of squills; the carbonate of ammonia, and myrrh, are also medicines of considerable efficacy; but squills are, by far, the most valuable expectorant of any in the whole materia medica; a blister should be applied to the chest, the vapour of warm water should be inhaled, and its effects will be increased, if the water is impregnated with æther; warm pediluvia, or the warm bath should be ordered; the respiration of an atmosphere, mixed with hydrogen gas, or any other innocuous air, which might dilute the oxygenous gas, would be useful in spasmodic asthma, by decreasing the sensibility of the system, and preventing the recurrence of the paroxysms; the respiration of an atmosphere, with an increased proportion of oxygen, is recommended in what is called the humoral asthma: in the intermissions, the remote causes should, as far as lies in our power, be carefully avoided; the use of fermented liquors, and particularly of distilled spirits, must be strictly in

habited, the diet should be light, of easy digestion, not flatulent, and the food should be taken in moderate quantities, taking care not to oppress the stomach; but when the disease has been of long continuance, a more full diet may be allowed; riding on horseback, or in a carriage, and more particularly a sea voyage, should, if convenient, be advised, or the patient should change the air, and try different situations, until, either by accident or by perseverance, he finds out a situation to live in, in which the disease is rendered less distressing, or is entirely removed; repeated blisters should be applied about the chest, or an issue be made in the neighbourhood: smoking tobacco is useful; and garlic or onions, by way of sauce, may be also found serviceable. Bark, chalybeates, and aloes should be had recourse to towards the close of the paroxysm.

Colic commences with an acute pain over the abdomen, the navel is twisted towards the spine, and the muscles of the abdomen are spasmodically contracted into separate portions, giving it the appearance of a bag full of round balls; there is vomiting of a bilious matter, obstinate costiveness, and generally coldness of the extremities; the urine is high coloured, is voided in small quantity, and with some degree of difficulty and pain; the disease is seldom attended with pyrexia in the first instance. Sometimes, however, an inflammation of that part of the intestine, where the disease is situated, supervenes, and aggravates the disease: when the peristaltic motion of the whole intestinal canal is inverted, the disease is called ileus, which is only to be regarded as a more violent degree of colic; it is, however, more apt to terminate in enteritis, or gangrene.

The removal of this disease will generally be effected by blood-letting, in the repetition of which we must be guided by the state of the pulse, violence of the attack, and strength of the patient; in all violent attacks of colic, if the patient be in tolerable vigour, it will not only be advisable, but proper to take away a moderate quantity of blood (except the disease arise in consequence of lead being received into the system), more particularly so if the pulse is full or hard, and there are any symptoms denoting a tendency to enteritis, it will, at the same time, be the means of relaxing the spasm, and procuring stools: the warm bath should be ordered, or the abdomen should be fomented, and strong peppers and spirits may be added to the fomentations; friction of the abdomen with warm oil, or bags filled with hot sand, or bladders filled with hot water, may be employed also with great advantage; blisters or rubefacients, together with warm pediluvia, will be requisite; antispasmodics should be administered internally, and where the disease has not been preceded by long costiveness, opium will be the most efficacious remedy, especially if vomiting prevents the exhibition of cathartics: where, however, the disease has been preceded by costiveness, the hyoscyamus will be found to be a more suitable remedy, as along with its narcotic it also possesses a gently cathartic quality: cathartics must be ordered, and they will be more efficacious when given in combination; calomel, above all, ought never to be given alone, its operation is always rendered more certain and easy by combining it with other cathartics, and the addition of a few drops of some essential oil will, in a great measure, obviate their griping effects; laxative clysters must be ordered; at first they should be mild, and tolerably large; the addition of a portion of oil, or of a solution of Epsom salts, will be an useful auxiliary; and if we do not succeed in procuring the evacuation of the intestines by the above means, we must have recourse to the injection of the smoke of tobacco, or a more certain and efficacious remedy is, a decoction of tobacco, in the proportion of half a drachm to four ounces of water, to be thrown up as an enema. If all the above means prove of no avail, we must have recourse to mechanical dilatation, as, by administering one or two ounces of the hydrargyrus every hour or two, or a large quantity of warm water should be injected by means of a large syringe: when every purgative, and even all other means that are in most common use, have failed, the action of the intestines has sometimes been effectual'y excited by throwing cold water on the lower extremities.

The *Colica Pictonum vel Saturnina*, or Colic from Lead, differs from the species above described, in not coming on in so sudden and violent a manner, and also in its cause, that of lead taken into the body, under various circumstances, as by exposure to the action of it, or by drinking cyder, or other liquors, impregnated with it; the disease generally commences with slight uneasiness in the bowels, or with a sense of weight, or of an aching, rather than an acute pain, about the navel, which is in-

creased after eating; the pain remits, and is sometimes relieved by pressure upon the abdomen: this, however, is frequently not the case. After a time the pain increases, becomes permanent, and intolerably excruciating; there is retraction of the umbilicus, the integuments of the abdomen, and the intestines are violently contracted, and drawn towards the spine, and the spasms are often so obstinate, that it is with the greatest difficulty a clyster can be thrown into the rectum; the pulse is hard and tense, there is obstinate costiveness, and often stranguary; after several attacks paralysis comes on, chiefly of the upper extremities, although there are numerous cases recorded, in which the lower are affected also, and sometimes it terminates in swellings of the joints, and loss of sight; sometimes, but more rarely, the disease is succeeded by paralysis after the first attack; the patients cannot rest in bed for the violence of the disease, and they find relief in walking about, if they have sufficient strength: those who have once laboured under the disease are very liable to relapse, in which case the disease comes on in a more violent manner than before, and the recovery is then more slow, and less complete. In the removal of this violent disease, we must, in the first place, restore the intestines to their natural irritability, by the exhibition of a large dose of opium; we should then administer some cathartic medicine at proper intervals, as the sulphate of magnesia or soda, or the phosphate of soda, dissolved in broth, or some aromatic fluid, castor or almond, may be given, combined with tincture of senna; and if the stomach be in a very irritable state, the medicines must be exhibited in the form of pills, for which purpose the calomel, joined with extract of jalap or colocynth, and a few drops of some essential oil, will be the most suitable; laxative clysters will be necessary, to which may be added some cathartic salt, or oil; the pain of the abdomen will be relieved by rubbing it with tepid oil, or by applying spiced fomentations, or by the warm bath, or by bags of hot sand, and similar antispasmodics; the application of a large blister to the abdomen is, however, a much more efficacious remedy. When we have relieved the urgent symptoms, the disease will, on its first attacks, be effectually removed by employing mercury internally and externally. Mercury must be pushed so far as to occasion some affection of the mouth as soon as possible, and the system must be kept under the influence of mercury, in a greater or less degree, according to the violence of the disease, for two or three weeks after every symptom of the disease has disappeared, as it is very apt to return, and with increased force. As a disposition to costiveness often remains, it should be obviated by some of the above cathartics. It sometimes happens that the pain in the bowels shifts suddenly, and attacks the head, causing extreme misery: in this case nothing affords so much relief as blisters applied to the back, behind the ears, and to the temples, successively, according to the urgency or continuance of the pain: opiates may be administered at the same time with advantage. The paralytic affections, which are the consequence of this disease, and the ileus, will be removed by the internal and external employment of Bath waters.

In *Diabetes* the most prominent symptoms, according to Dr. Rollo, are voraciousness and keenness of appetite, or a frequent craving for food, without the feel of entire satiation; a parched mouth, with constant spitting of a thick viscid phlegm, of a mawkish, sweetish, or bitterish taste; intense thirst; a whitish tongue, with red bright sides; red and swelled gums, with the teeth feeling as on edge from acids, and loose in their sockets; head-ach; a dry hot skin, with flushing of the face; a pulse most generally about eighty-four or six; an increase of clear urine, of a light straw colour, having a sweetish taste, resembling sugar, or rather honey and water; an uneasiness of the stomach and kidneys; a wasting of the flesh, a weariness and disinclination to motion or exertion, with the feeling of weakness; an excoriation, with soreness of the glans, penis, and prepuce, which is sometimes swelled, and there is no desire of venery: in females there is a peculiar uneasiness about the meatus urinarius.

The predisposing *causes* of this disease are at present obscure, but the disease has been found to occur in those who have indulged in fruits, sweetmeats, pickles, high-seasoned food, warm, stimulating condiments, wine and fermented liquors, or indulgence even in farinaceous foods, with large quantities of small beer, accompanied by great bodily exercise, with or without active mental employment; moisture, grief, vexation or agitation of mind, sudden variations of temperature may also be regarded as predisposing or exciting causes. The proximate cause is supposed to be a mor-

bidly increased action of the stomach, with consequent secretion, and vitiation of the gastric fluid, marked by an eagerness of appetite and acidity; the direct effects of which are the formation or evolution of saccharine matter, with a certain defect of assimilation, preventing the healthy combinations, and exciting the immediate separation of the imperfectly formed chyle by the kidneys. Dr. Baillie thinks it probable, that diabetes depends, in a considerable degree, upon a deranged action of the secretory stucture of the kidneys, by which the blood there is disposed to new combinations; the effect of these combinations is the production of a saccharine matter: he further thinks it probable, at the same time, that the chyle may be so imperfectly formed, as to make the blood be more readily changed into a saccharine substance, by the action of the kidneys; an opinion well worth minute enquiry.

The *cure* of this disease consists in confinement, an entire abstinence from every species of vegetable matter, a diet solely of animal food, and that in as small quantities as the stomach will be satisfied with; emetics, hepatised ammonia and narcotics will be necessary, and they should be assisted by the daily use of alkalies and lime water; the hepatised ammonia should at first be exhibited in doses of five or six drops, three or four times a day, the dose is to be gradually increased, so as to produce some degree of nausea, or slight giddiness, it should not be mixed up in draughts, or in any other form, as it is readily decomposed, but it should be dropped from the phial, at the time of using it, into a proper vehicle, and taken immediately, distilled water is the best vehicle; an opiate should be administered at bed-time, with from twenty to thirty drops of the antimonial wine; this plan is to be pursued until the morbid condition of the stomach is removed, the marks of which are, a scarcity and high-coloured state of the urine, with turbidness, furnishing, on evaporation, an offensively-smelling and saltish-tasted residuum without tenacity, accompanied with a want of appetite, and loathing of food: at this time the tongue and gums will be found to have lost their florid red clour, and to have become pallid. When this state occurs, exercise is to be enjoined, and a gradual return to the use of bread is to be allowed, and vegetables, such as brocoli, spinach, peas, cauliflower, cabbage, lettuce, and parsnip, in moderate quantity: these last have been observed to have been eaten with impunity. The drink should consist of such liquors as afford the least saccharine matter, as weak brandy or rum and water, with the occasional use of bitters. Costiveness must be obviated by gentle laxatives, as flowers of sulphur, oil of castor, or aloetics, combined with soap. The exciting and keeping up a degree of nausea, with proper doses of tartar emetic, is recommended in the early stages of the disease; the camphor and other narcotics, besides opium, are deserving of a trial: alum whey, which is made by boiling a drachm of the alum in a pint of milk, is said to considerably reduce the quantity of urine: nut galls and lime-water have been employed with success.

ORDER IV. *Vesaniæ*. INTELLECTUAL DERANGEMENTS.

Disorders of the judgment without pyrexy or coma. The following are the genera. 1. Amentia; an imbecility of judgment, by which people either do not perceive, or do not remember, the relations of the things: the species are three; connate, from old age, from evident external causes. 2. Melancholia, a partial madness, without dyspepsy or indigestion: varying according to the different subjects concerning which the person raves; and hence, admitting an almost infinite multiplicity of varieties. 3. Mania, universal madness; idiophathic and symptomatic; under the former section, mental and corporeal, or arising from some evident disease of the body: under the latter, proceeding from poisons, from passion, from febrile affection, and hence rather referable to the corporeal species. 4. Oneirodynia, a violent and troublesome imagination in time of sleep. Two species; O. activa, somnambulism, or sleep-walking: and O. gravans, night-mare.

To *Mania*, with which Melancholia is so nearly allied, we shall devote an observation or two.

Mania often arises from intense study, violent emotions of the mind, unrestrained passions, long exposure to the scorching rays of the sun, overstraining the faculties of the mind, intemperance, organic affections of the cranium, an hereditary disposition, sanguine temperament, long-continued melancholy, suppressed evacuations, repelled eruptions, and religious enthusiasm. The proximate cause is supposed to consist in an increased excitement of the brain. It is distinguished from phrenitis by the ab-

sence of the pyrexy and head-ache, and from delirium by the state of the pulse, by the patient not knowing the place where he is, nor the persons of his friends or attendants, and from not being conscious of external objects, except when roused, and even then he soon relapses into a state of inattention; whereas in mania, he is frequently sensible, and is continually planning the means of preventing or revenging supposed injuries, and frequently the resentment is directed against his dearest friends.

Treatment. According to Dr. Darwin, the circumstances which render confinement necessary are, the lunatic being liable to injure others, or himself, or not being able to take care of his own affairs; and if none of these circumstances exist, there should be no confinement: for he remarks, though the mistaken idea continues to exist, yet if no actions be produced in consequence, the patient cannot be called insane, but only delirious: and he adds, that if every one who possesses mistaken ideas, or who puts false estimates on things, were liable to confinement, he does not know who of his readers might not tremble at the sight of a madhouse. It will, however, in the first instance, always be proper to gain a complete ascendency over the patient, either by gentle or coersive measures; his anger and violent passions must be restrained by the straight waistcoat; he should be kept in silence and darkness, and as much as possible in an erect posture; none of his intimate acquaintance or friends should be allowed to visit him. At the commencement of this disease, blood letting may be employed with advantage; the blood should be taken from a large orifice, in such quantity as to induce some tendency to deliquium animi: when the temporal artery, or jugular vein, can be conveniently opened, it should be preferred. If the disease have been of considerable duration, bleeding will not be advisable; a solution of the gum ammoniacum with Glauber's salts should be given daily, so as to keep the bowels pretty laxative; the head should be shaved, and cloths, moistened with the coldest water, pounded ice, or water artificially rendered so, should be gently wrung, and applied constantly to the head; they should be renewed as soon as they acquire any heat, until a sense of cold and chilliness be induced, when they are to be left off, and had recourse to again when necessary, or the affusion of cold water upon the head may be substituted; it should be poured from a considerable height: it is recommended to put the patient into the warm bath up to his shoulders, and then to pour cold water upon the head, previously shaved; vomits, consisting of from five to ten grains of tartar emetic, are recommended to be given every three or four days, for two or three weeks; opium and camphor have been employed in large doses, and frequently with advantage; the digitalis has been found particularly serviceable, it should be exhibited in gradually repeated doses, and continued until a degree of sickness is induced, or till the frequency of the pulse suffers a considerable diminution, it must then be left off, and again renewed when its effects on the constitution begin to wear off; the gratiola has been recommended in doses of ten grains, two or three times a day; hard labour, and long-continued journeys have, in some instances, effected a cure; it is proper to remark, that the pulse in mania, is sometimes full and strong; when this occurs, evacuations and diluents will be necessary; at other times, the pulse is quick and weak, in this case a more nourishing diet, bark, chalybeates, and small doses of opium, will be proper; in general, the patient should be allowed only a low and spare diet; blistering has not been found of service, except at the commencement of the disease; the affusion of warm water on the surface of the body, that is, water of the temperature of the blood and upwards, is often employed with soothing effects. The cold bath is strongly recommended in the height of the paroxysm, except the digestion is much impaired, or the vigour of the circulation is much debilitated; the patient should be thrown in headlong, and as he comes out he should be thrown in again, until he becomes calm and rational, or very much debilitated. Though in mania the temperature of the body is little, or not at all, increased, maniacs retain the actual heat with great tenacity; and under the above restrictions the cold bath may often be applied with advantage, and always with safety. After the disease is removed, it will be proper to administer bark, chalybeates, the oxide, or sulphate of zinc, and the sulphuric acid.

CLASS III. CACHEXIÆ.

DEPRAVED HABITS.

A depraved habit of the whole or greatest part of the body, without primary pyrexy, or neurosis. The following are the orders of this class:

ORDER I. *Marcores.* DECLINES.

This order includes the following genera: 1. Tabes; leanness, debility, hectic pyrexy. Three species: purulent, scrophulous, and from poison taken internally. 2. Atrophy; differing from tabes in being without hectic pyrexy. The species are from too great evacuation, from a deficiency of nourishment, from corrupted nourishment, from decay of the nutritive organs.

In *tabes* and *atrophy* the cure may best be effected by the removal of the remote causes, or the idiopathic diseases on which they depend; the tabes mesenterica is sometimes an idiopathic disease, in which there is great debility, emaciation, and paleness; there is, at the same time, enlargement of the head and abdomen; it will be effectually removed by small doses of calomel, or of the murias hydrargyri, the doses must not be so large as to excite catharsis; the mercury is intended only to act as an alterative; the solutio muriatis calcis is deserving of an unbiassed trial; the cure will be accelerated if we, at the same time, employ chalybeates, combined with a neutral salt, with fossile alkali, or with rhubarb, in such doses as to act moderately upon the bowels; the employment of a tepid salt-water bath, or washing the patient with a solution of salt, night and morning, will also be of service.

ORDER II. *Intumescentiæ.* MORBID SWELLINGS.

An external tumour of the whole or greater part of the body. These are adipose, flatulent, or aqueous, forming three distinct sections. Of the first is, 1. Polysarcia, corpulency. Of the second are, 2. Pneumatosis, a tense elastic swelling of the body, crackling under the hand. 3. Tympanites, a tense, elastic, sonorous swelling of the abdomen, costiveness, a decay of the other parts. Two species: intestinal, and abdominal. 4. Physometra, a slight elastic swelling in the epigastrium, having the figure and situation of the uterus. Under the third section we have, 5. Anasarca, a soft inelastic swelling of the whole body, or some part of it; arising from a multitude of causes, and hence admitting of a multitude of species. 6. Hydrocephalus, a soft inelastic swelling of the head, with the sutures of the cranium opened. 7. Hydrorachitis, a soft slender tumour above the vertebræ of the loins; the vertebræ gaping from each other; formerly denominated spina bifida. 8. Hydrothorax, dropsy of the chest; dyspnœa; paleness of the face; œdematous swellings of the feet; scanty urine; lying down difficult; a sudden and spontaneous waking out of sleep, with palpitation; water fluctuating in the chest. 9. Ascites, a tense, scarcely elastic, but fluctuating swelling of the abdomen. Two species: one A. abdominalis, extending over the whole abdomen, with an equality of tumour, and a fluctuation sufficiently evident, arising from an obstruction of the viscera, from debility, or from thinness of the blood; the other, A. saccatus, confined in a bag, the swelling more partial, and the fluctuation less evident. 10. Hydrometra, dropsy of the womb, a swelling of the female epigastrium, gradually increasing, preserving the shape of the uterus, yielding to pressure, and fluctuating, without ischury or pregnancy. 11. Hydrocele, swelling of the scrotum, not painful, increasing by degrees, soft, fluctuating, and pellucid. 12. Physconia, a swelling chiefly occupying a certain part of the abdomen, and neither sonorous nor fluctuating. The species are very numerous, and named from the part the disease occupies, whence we have physconias hepatic, splenic, venal uterine, &c. 13. Rachitis, rickets, a large head, swelling most in the fore-part, the ribs depressed, abdomen swelled, with a decay of the other parts. It varies merely in being simple, or conjoined with other diseases.

From this list it will appear obvious that a preternatural collection of serous, or watery fluids, is often formed in different parts of the body; and although the disease arising from it is distinguished by different names according to the various parts occupied, these collections all come under the general appellation of dropsy. When water is diffused through a part, or the whole of the cellular membrane, the disease is called anasarca; when there is a collection of water within the cavity of the cranium, it is named hydrocephalus internus; when upon the vertebræ of the loins, it is called hydrorachitis; when within the cavity of the thorax, it is named hydrothorax; when it is contained within the cavity of the abdomen, it is called ascites; when in the uterus, hydrometra; and when it is collected within the scrotum, it has the appellation of hydrocele. We can only notice a few of these.

The removal of *anasarca* must be at-

tempted by removing the remote causes, which still continue to act, by evacuating the collected fluid, and by restoring the strength of the system. The remote causes are often such as have been removed before the disease occurs, although their effects continue; for the most part, these causes are certain diseases, or habits, previous to the occurrence of the disease, which are to be cured by proper remedies, adapted to their causes, and by desisting in particular from indulgence in the use of ardent spirits, when the origin of the disease can be traced from that source; the collected fluid must be drawn off by scarifications, the punctures of which must be made small, and at some distance from one another, as there is a tendency in wounds, made in dropsical cases, to become gangrenous; issues, or the daily application of a thin slice of mezereum, steeped in vinegar, will be proper; they should be made a little below the knees; colewort leaves should be applied to the feet and legs, which must be removed occasionally as they become imbued with moisture; or booterkins should be made of oiled silk, and bandages should be applied to the lower extremities; emetics are also very serviceable, they should consist of ipecacuanha, tartar emetic, or squills, with a few grains of the sulphate of copper; the most powerful remedies, however, are cathartics, which dropsical patients in general bear more easily than emetics; those in most general use are, gamboge, jalap, colocynth, scammony, calomel, and elaterium: this last should be exhibited in the form of a pill, or given in diluted spirits, in doses of half a grain or more, every hour, until vomiting or catharsis is excited; but the most powerful remedy is the crystals of tartar, which should be administered in doses of two drachms every hour, till copious evacuations are procured either by stool or urine, giving at the same time tepid liquids plentifully; this medicine should be repeated every, or every other, morning, according to the strength of the patient. As the thirst is a very distressing symptom in this disease, the patient should be allowed to take as much water, or mild mucilaginous liquids, acidulated with the crystals of tartar, as he feels disposed for; bottled cyder, drank in considerable quantities, is sometimes of service; diuretics must be administered, and they should be combined with tonics and aromatics, or with essential oils. The most powerful medicine of this class, however, is the digitalis, and it is most efficacious when joined with some of the above diuretics; it should be given in such doses as to effect the state of the pulse, and if it do not speedily afterwards act as a diuretic, it will be of little avail to persevere in its exhibition; as the perspiration is often greatly diminished, diaphoretics have sometimes been employed with advantage, or opiates combined with ipecacuanha, and the action of the vessels upon the surface will be excited by friction, particularly in the morning, and it will be more serviceable if made from below upwards; if the above methods should be of no avail, we must try mercury, and it should be pushed so far as to affect the mouth, and its effects on the system must not be allowed to cease until the swelling subsides. The debility of the system will be removed by studiously avoiding all the remote causes in our power, by gentle exercise, by supporting the integuments of the lower extremities by means of bandages properly applied, as a well-constructed laced stocking, and by the employment of bark, quassia, sulphuric acid, and chalybeates, and they will be more efficacious when combined with diuretics; the vapour-bath has been employed with considerable advantage, especially when assisted by frictions; if the disease arise in consequence of obstructions of the viscera, or siphilis, some of the preparations of mercury will be necessary, employing at the same time chalybeates and tonics. The pulse has been sometimes, although rarely, found full, hard, and tense, in which case blood letting is advisable.

Hydrocephalus generally attacks children, and very often comes on in a very gradual manner; one of the earliest criterions is the patient being uneasy on raising his head from the pillow, and wishing to lie down again immediately; it frequently commences with languor, pains in the limbs, and head-ach; the patient is affected with nausea and vomiting several times in the course of the day, the pain of the head is usually confined to one side, or extends from just above the eye-brows to the temples; sometimes, however, it is universal over the whole of the head; the head-ach frequently alternates with the affection of the stomach, and the head is now and then observed to lean more to one than the other side; the eyes are painfully sensible to the light, there is moaning and watchfulness; or, if the patient sleep, he grinds his teeth, picks

his nose, and often awakes suddenly in a fright; the bowels are costive, and are with difficulty acted upon by the strongest purgatives; the pulse is more frequent than in health, but regular; these symptoms go on increasing, the pupils become dilated, and the axis of the eyes are turned in different directions; the vomiting and pain of the head become more distressing, there is some difficulty of breathing, the heat of the body, and of the head in particular, is increased, pyrexy comes on, of which there are perfect intermissions many times in the course of the day, with an evident exacerbation in the evening; the countenance is occasionally flushed, and the pulse, from being frequent, now becomes slow and irregular; as the disease advances the pain of the head somewhat abates, and a degree of stupor or coma succeeds the watchfulness of the former stage, and if the patients be roused they are fretful, and often utter dissonant and loud screams, the hands are often lifted up to the head, and the strabismus becomes more considerable, the pupils are more dilated, and scarcely contract when exposed to a strong light; sometimes there is a total defect of vision; they swallow liquids with unwillingness and some apparent difficulty; the vomiting now ceases, the disposition to costiveness continues, now and then, however, dark stools are evacuated, in which worms are frequently observed; when the disease has continued in this state for a few days, the pulse again becomes regular and frequent, but very weak; the breath is drawn with difficulty, and with a stertorous noise, the patient is frequently affected with loud shriekings, red spots appear on different parts of the body, particularly about the joints, and at length convulsions come on, and close the scene.

Treatment. As this disease frequently runs rapidly to its fatal termination, we must employ the most active remedies in the first stage: the most powerful remedy, at the commencement of this deplorable disease, is blood letting: in children it will be sufficient to apply leeches to the temples at proper intervals; in adults we may, with great propriety, employ general blood letting; commonly, however, local blood letting will be most serviceable: costiveness must be obviated by the more active cathartics, as calomel, combined with gamboge, scammony or elaterium, and by the employment of clysters; the head should be shaved, and a large blister applied over the whole of it, or between the shoulders; it will be proper to keep up the discharge occasioned by the blister for some time, in which case an alternation of them from the head to the back, or behind the ears, will be attended with more beneficial effects than a perpetual blister; the velocity of the circulation will be diminished by the exhibition of the digitalis, and if we have reason to conclude that an effusion has taken place, the absorption of the fluid will be promoted by combining the digitalis with calomel; the latter must, however, be administered at proper intervals, in such doses as will produce some affection of the mouth; opiates should be given at the same time, and if the patient be very much debilitated, it will be proper to exhibit bark and chalybeates; errhines may be tried, as one grain of turbeth mineral, mixed with from ten to fifteen grains of sugar, or liquorice powder, this should be gradually blown up the nostrils; frequent electric shocks, from very small charges, are recommended to be passed through the head in all directions. The hydrocephalus is sometimes symptomatic of worms, disorders of the bowels, or mesenteric affection; when this is the case, the disease will generally be removed in a short time, by the employment of mercurial cathartics, combined with other active purgatives, by blisters, and by some of the preparations of iron.

Rachitis. This disease seldom makes its appearance before the eighth or ninth month, or after the second year of the child's age; it appears first with a flaccidity of the muscles, and falling away of the flesh, although the food is taken in in large quantities. If the child be able to walk, a difficulty of breathing and palpitation of the heart will be perceived on its walking a little faster than usual; the face is pale and somewhat bloated, and the child becomes daily more averse to exercise or motion; the head appears large in respect to the body, and the forehead becomes unusually prominent; the fontanelle and sutures are more open than usual, the ribs lose their convexity and become flattened at the sides, and the sternum is pushed outwards and form a sort of ridge; the joints become enlarged, while the limbs between them appear, or become slender, and variously distorted; the spine of the back, in particular, becomes very much incurvated, and the whole figure is sometimes distorted in such a manner as to resemble the letter S; the abdomen is hard and preternaturally tumid, and the other parts of the body are emaci-

ated; the appetite is but little, or not at all, impaired, and the stools are frequent and loose; the dentition is not only slow, but later than usual, and the teeth, soon after their appearance, become decayed, and frequently fall out; the faculties of the mind are sometimes impaired, more frequently, however, they possess a premature acuteness of the understanding. On the first appearance of the disease the system is but little affected, but after a short time febrile symptoms are generally present: the disease after awhile often ceases to advance, and the health is re-established, but the limbs remain distorted; in other cases, it goes on increasing till every function is affected, and at length terminates in death, in consequence of inability to distend the chest, owing, in all appearance, to the softness of the bones. In the bodies of those who have died of this disease, various morbid affections have been discovered in the internal parts in particular; the abdominal and thoracic viscera have been found in a diseased state, and the bones are sometimes so soft that they can be readily cut through with a knife.

The remote causes are, debility, an impure and humid state of the atmosphere, poor milk, hereditary disposition, bad air, deficiency of proper exercise, want of cleanliness, and an improper diet. The proximate cause is supposed to be a deficiency of calcareous earth and phosphoric acid.

The *removal* of this disease will be affected by gentle emetics in the first instance; it will not, however, be necessary to repeat them very frequently: bark should be administered in moderately large doses; but as there is often a difficulty in administering it in substance, in proper quantities, the extract of bark is to be preferred, or the oxyde or sulphate of zinc, or some of the preparations of iron must be employed, and they will be more efficacious if administered in combination with calcined hartshorn or chalk, or with a neutral salt and rhubarb, in such proportion as will keep the bowels gently laxative; the phosphate of lime and of soda are recommended, in equal parts, to the extent of a scruple, twice a day; and washing the surface of the body with a solution of potash, in the proportion of half an ounce to a pint of water, morning and evening, is also of service, taking care, however, to wipe the skin perfectly dry; the body must be well rubbed with flannel, and the dorsal spine should be rubbed with volatile alkali; the diet should be light and nourishing, and port wine should be allowed; exercise in the open air, in dry weather, should be strictly enjoined, and as gestation can only be employed, the child should always be carried in a horizontal posture, as moving them in any degree of an erect one is liable to increase the distortion, and they should lie down frequently in the course of the day; and some of the ingenious contrivances, mentioned in the Zoonomia, should be employed. The cold bath may be made use of, or a bath of the temperature of the Matlock bath, which is 66°, or of the Buxton, which is 82°, would perhaps be preferable, and more beneficial. The prophylaxis consists in cold bathing, frictions, and proper exercise.

ORDER III. *Impetigines.* EXTERNAL DEFORMITIES.

Cachexies chiefly deforming the skin and external parts of the body.

The following are the genera of this order: 1. Scrophula, king's evil: swellings of the conglobate glands, especially in the neck; swelling of the upper lip and support of the nose; the face florid, skin thin, abdomen tumid. Four species: common, mesenteric, temporary, from resorption of the matter of ulcers in the head; and West Indian, catenated with the yaws. 2. Siphilis, venereal disease, a contagious malady after impure venery, and a disorder of the genitals; ulcers of the tonsils, of the skin, especially about the margin of the hair; corymbous papulæ, terminating in crusts and crusty ulcers; pains of the bones and exostoses. 3. Scorbutus, scurvy. In cold countries, attacking after putrescent diet, especially such as is salt and of the animal kind, and when there is no supply of fresh vegetables; asthenia; stomacace; spots of different colour on the skin, for the most part livid, and appearing chiefly among the roots of the hair. 4. Elephantiasis, Arabian leprosy, a contagious disease; thick, wrinkled, rough, unctuous skin, destitute of hairs; anæsthesia in the extremities; the face deformed with pimples; voice hoarse and nasal. 5. Lepra, Greek leprosy, skin rough, with white branny and chopped escars, sometimes moist beneath, with itching. 6. Framboesia, yaws, swellings resembling funguses, or the fruit of the mulberry or raspberry, growing on various parts of the body. This disease is placed by some nosologists in the class and order Pyrexiæ, Exanthemata, as constantly

accompanied with pyrexy, and only attacking a man once during life. 7. Trichoma, bleeding hair, a contagious disease; the hairs thicker than usual, and twisted into inextricable knots and cords. It is almost confined to certain parts of the north of Europe; and rarely extends out of Poland. 8. Icterus, jaundice; yellowness of the skin and eyes; white feces; urine of a dark red, tinging what is put into it of a clay colour. Five species; calculous, spasmodic (after spasmodic diseases of the mind); hepatic, from pregnancy; and infantile, attacking infants a few days after birth; for which last see the article INFANCY.

Scrophula. The symptoms are known too generally. The most efficacious remedies which can be employed are, sea bathing, and the internal use of salt water, a change to a warm climate, and a nourishing diet. A trial of the chalybeate and sulphureous waters should be recommended; the digitalis and a solution of muriate of barytes have often been administered with evident advantage; the latter appears to be a medicine well calculated to correct the scrofulous diathesis; bark, combined with carbonate of soda, is strongly recommended; the preparations of iron should be ordered, and a small quantity of rhubarb should be joined with them; a grain or more of opium, twice a day, is sometimes of service: hemlock is getting into disuse, perhaps undeservedly.

The external remedies most suitable for scrophulous tumours and ulcers are sea water poultices, and bruised sea-tang; the leaves of wood-sorrel (oxalis acetosella) bruised, are strongly recommended, and appear to have been employed with advantage; linen rags, kept constantly moistened with a solution of the sugar of lead, or of muriated mercury, should be applied to the parts affected; a small quantity of a powder composed of seven parts of bark, with one part of white oxide of lead, is recommended to be applied to scrofulous ulcers, by means of lint and a bandage, and renewed daily; or they may be sprinkled with carbonate, or oxide of zinc; it will be proper always to apply moderate pressure upon the parts, which will tend to heal the ulcers; oxygen gas has been employed with evident advantage; electricity might perhaps produce good effects, if had recourse to at the commencement of the disease; the solution of muriate of lime is strongly recommended, and it is certainly deserving of a full and fair trial; the dose should be gradually increased, and when qualms and sickness are produced, we may consider these as signs of an over-dose; it is also proper to observe, that it is sometimes necessary to employ gentle laxatives under its use, as it is apt to induce costiveness.

Scorbutus. Soreness of the gums, with a spongy swelling, and bleeding upon the least touch; the face lurid, bloated; ancles œdematous; lassitude and depression of spirits; pains in the limbs and thorax; the hands contracted and rigid; the debility increasing, so that at length a simple attempt to acquire an erect position is productive of syncope, or even death; the appetite for food is generally unimpaired; in every stage of the disease the skin becomes dry and rough, and the urine is scanty and high coloured; vibices appear in different parts of the body, and there are small specks, generally of a purple colour, very little raised above the surface of the skin, and if a part be bruised, in any stage of the disease, ecchymosis immediately takes place; the pulse is generally weak, the tongue is of its natural appearance, the bowels are either very much confined, or the patient is troubled with diarrhœa, accompanied with griping pains. In the last stage of the disease the breath becomes remarkably fetid; the urine, after it has been voided some hours, is covered with an oily pellicle; and blood issues from the mouth, nose, anus, urinary passages, sometimes even from the ends of the fingers and pores of the skin. There is a remarkable symptom sometimes attendant on this disease, even in its incipient state, mentioned by Dr. Blane, in his valuable work on the Diseases of Seamen, in which the patient complains of an almost total blindness towards evening, when no other visible symptom of the disease is present; but the complaint uniformly betrays itself by ecchymosis, in cases of bruises, or by scorbutic ulcers, which are very difficult of cure. It chiefly affects sailors, and people shut up in besieged places, who are deprived of fresh provisions and vegetables; this, however, is not always the cause, as, in cold climates, it is sometimes produced by a very scanty, though not salt diet, under the influence, at the same time, of cold, damp, and foul air, and indolence.

Treatment. This disease will be most certainly removed by fresh vegetables, and the expressed juice of lemons, limes, oranges, and other subacid fruits; the two first are, however, the most powerful antiscorbutics

and it is worthy of remark, that the recovery will be more speedy when fresh vegetables alone, and no animal food are employed, than when fresh animal food is made use of without vegetables: the essence of malt, or of spruce, will often be found of considerable service. As there is generally an obstruction of the perspiration, we should endeavour to excite a gentle diaphoresis by means of the pulvis ipecacuanhæ compositus, or by camphor, combined with nitre and opium; vegetables are particularly useful, such as celery, water-cresses, cabbages, mustard, horse-radish, and many others of the class Tetradynamia. As a free flow of urine is found to promote recovery, we should endeavour to solicit it by means of some of the preparations of squills; wine, chalybeates, bark, and the mineral acids, should be exhibited; when lime or lemon juice cannot be procured, sourkrout, and what in Scotland is called souins, are very useful articles of diet: a solution of nitre in vinegar, in the proportion of from two to four ounces of the former to a quart of the latter, is strongly recommended; from one to two ounces, or more, may be given two, three, or four times, in the course of the day. The sponginess of the gums will be removed by a solution of the alum, or by astringent gargles, in which muriatic acid is a component part: the contraction of the hams, and the livor and hardness of the calves of the legs will be relieved by warm fomentations and emollient poultices. A poultice of wood-sorrel should be applied to the ulcers, or if that cannot be procured, the nitrous vinegar may be employed; but the best application is lemon juice. The remote causes must, as far as lies in our power, be avoided; the greatest attention must be paid to cleanliness; exercise must be enjoined; and the air must be corrected by fires and ventilation. The only certain preventatives are, fresh vegetables, exercise, and the nitric acid. Oxygen should be introduced into the system, by such medicines as are known to contain it, or by inspiring it when chemically produced.

Jaundice is easily discovered from the yellow hue it produces. The cure consists in the removal of the exciting causes, and the alleviation of urgent symptoms; the most frequent exciting causes are calculi, the passage of which will be promoted by gentle emetics; for this purpose ipecacuanha is the best medicine; it should be exhibited in small and divided doses, so as to occasion, for a time, a degree of nausea, but ultimately to produce its full effects: the costiveness must be removed by the calomel, combined with rhubarb and soap, or by administering oil of castor. Where the pain is very violent, attended with a slow pulse, the warm bath, and fomentations of the epigastrium, will be necessary, or bladders filled with hot water, or bags of hot sand applied to it; opiates will be very serviceable, but as there is costiveness, the inspissated juice of henbane would be a preferable medicine; æther, with yolk of egg, is recommended as having a tendency to dissolve inspissated bile; unboiled acrid vegetables are useful, as lettuce, mustard, cresses, &c.; electric shocks should be passed through the duct at proper intervals; mucilaginous diluents should be freely allowed, and emollient clysters should be frequently injected. In cases of pyrexy, attended with local pain and dyspnœa, blood letting and the antiphlogistic regimen may be employed with great advantage; and after the pain is removed, and the arterial energy becomes weakened, some of the preparations of iron may be used with great benefit; Seltzer, or soda water, should be drank in moderate quantities, or it may be made at the time of taking it, by dissolving a drachm of the carbonate of soda in a pint of water, and adding twenty drops of muriatic acid, drinking it off as soon as mixed; or, instead of the muriatic acid, it may be saturated with carbonic acid, by means of Dr. Nooth's glass apparatus. There is an artificial sort of Seltzer water sold in London, which is prepared in a much better manner than we are able to do it in general; and the name of the proprietor is Schweppe. If the disease arise in consequence of tumors, or pressure of surrounding parts, small doses of calomel, or some other preparation of mercury, may be useful, employing, at the same time, some of the preparations of iron, or natural chalybeate waters; gentle exercise on horseback is particularly serviceable in promoting the passage of calculi, and preventing the stagnation of bile in the gall-bladder.

CLASS IV. LOCALES.

LOCAL AFFECTIONS.

A reference to the nosological table of the system we have selected in this work, will prove this class to be of a very voluminous, as well as of a very complicated nature: and as we have already observed, intended to take in every disease which could not easily be introduced under the preceding classes. More than half the ma-

ladies of which this class consists belong to the department of surgery; such as, for instance, all the genera in the order Tumores, and many of those in the order Dialyses. Of the rest, many are altogether incurable, and many may more conveniently be described nnder the article MIDWIFERY. On this account, instead of giving a detail of the entire genera of which the present class consists, with their definitions and modes of treatment, we shall refer the reader to the previous table for their respective names and arrangements; and shall only select, for further remark, those that appear of more prominence and general importance than the rest, and which can only with propriety be described in the present article.

Amaurosis, loss of sight, without visible cause or injury. In this disease the eyes appear natural; but the pupil is dilated, and does not contract upon being exposed to the strongest light: it is sometimes attended with head-ach. The remote causes are, compression of the brain, either from conjestion or mechanical pressure; cararact; atony; paralysis of the optic nerve, or inirritability of it. The proximate cause is the insensibility of the retina. If the disease arise from the first-mentioned cause, it may be removed by the means necessary in those cases: when it arises from atony, or paralysis of the optic nerves, we must employ stimulants, as blisters to the temples; electricity is of singular service; sparks should be taken from the eyes, and shocks should be sent through the head: errhines will be very useful, as turbeth mineral, in the proportion of a grain to eight of liquorice powder, one-fourth of which is to be snuffed up the nostrils once or twice a day; and we must at the same time employ the internal stimulants recommended in the treatment of paralysis: opium and muriated mercury, in doses of a quarter of a grain of each twice a day, a blister on the crown of the head, and repeated minute electric shocks, passed through the eyes, are recommended in the early stages of this disease. The cataract, as requiring a surgical operation, does not properly come under consideration.

Albugo, or opacity of the transparent cornea, which often remains after inflammation or siphilis, may sometimes be removed by repeated blisters on the temples. The long-continued use of electricity, and the aqua ammoniarœ ti cupris should be introduced into the eye, and it will sometimes require dilution; or prepared glass, reduced to an impalpable powder in a mortar of agate, and mixed with honey or mucilage, is to be applied to the eyes by means of a camel hair pencil, two or three times a day. The linimentum sepiæ compositum, and infusion of Guinea pepper, are recommended in strong terms, and are certainly deserving of a trial.

Of *deafness* the causes are innumerable. It may be a defect in the organ of hearing, too great dryness of the ear, hardened accumnlated wax obstructing the passage of sounds; inflammation of the membrana tympani; inflammation or obstruction of the eustachian tubes; siphilis; and atony, or paralysis of of the auditory nerves. When it arises in consequence of organic affection, all our endeavours will generally prove fruitless; but when it arises from obstruction of the eustachian tube, it will be commonly removed by punctnring the membrana tympani: if from too great dryness of the ear, a few drops of a mixture composed of half an ounce of oil of almonds and forty drops of oil of turpentine is recommended. It should be applied to the internal ear by means of a dossil of cotton, taking care to keep the cavity clean, by wiping it daily with a large camel-hair pencil. If it arise from hardened wax, the interior cavity must be softened by frequently injecting warm water and soap, or a solution of sea-salt in as much water as will barely dissolve it, which last is an excellent solvent of the wax. The ear may afterwards be cleansed by syringing it with warm water. The wax may also be softened by occasionally insinuating into the ear a few drops of a mixture composed of three parts of ox-gall and one part of the balsam of Peru. This is also of service when there is a fetid discharge from the ear, or a diseased state of its secretions. When it arises in consequence of inflammation, topical blood letting, blisters behind the ears, and exclusion of the external air, will be necessary. If the disease proceed from an affection of the eustachian tubes, stimulating gargles and injections will be proper, at the same time powerful errhines may be employed; and where the patient hears better when there is a loud voice, he should stop the mouth and nostrils, and force the air into the tubes by violent efforts of expiration; and if one effort be not sufficient for that purpose, he should employ repeated ones. When it is induced by atony, or paralysis, æther, garlic-juice, and other stimulants, should be applied by means of a dossil of cotton: errhines also are of considerable utility, and should be snuffed up the nose

two or three times a day. Blisters behind the ears, electricity, and internal stimulants, will likewise prove useful auxiliaries. If the disease arise in consequence of siphilis, we must apply to a full course of the mercury. Whenever deafness is not easily removed by the ordinary means, the application of blisters behind the ears will often be of service.

Enuresis, involuntary flow of urine. The causes are, atony, or paralysis of the sphincter of the bladder; irritation or compression of the vesica urinaria; the latter period of pregnancy; laxation of the vertebræ. If the disease proceed from atony, the perinæum must be frequently bathed with cold water; repeated blisters must be applied to it and to the os sacrum. We should at the same time administer internal tonics and stimulants, as bark, zinc, and some of the preparations of iron, tincture of cantharides, and the cold bath. If it be induced by paralysis, blisters, electricity, and internal stimulants must be employed: if from irritation, or compression of the bladder, the cause of it must be discovered, and the proper means of removing it be had recourse to; and if it be a consequence of the pressure of the gravid uterus, the patient should be kept as much as possible in a horizontal posture.

Ischuria. Of this disease there are four species; as affecting the kidneys, ureters, bladder, or urethra. The first proceeds from nephritis, calculi, spasm, grumous blood, or pus in the pelvis of the kidneys, paralysis, and sometimes inflammation of the intestines, or mesentery. If the disease arise from the first-mentioned cause, which will be readily discovered by a careful attention to the symptoms, it will be removed by the means pointed out when treating of that inflammation: if it be the consequence of calculi, which will be known by the attendant symptoms, which are a frequent desire of making water, often suddenly stopped as it flows in a full stream; heat and pain soon after the evacuation of it; tenesmus; an itchiness of the anus and extremity of the urethra; colic pains; costiveness; nausea; and frequently vomiting, pain and retraction of the testes, and pain or a sense of weight in one or both thighs. Blood-letting will be requisite, in proportion to the violence of the symptoms of excitement. Laxatives will at the same time be necessary, and the antiphlogistic regimen must be strictly adhered to. The irritation will be allayed by the employment of the warm bath, fomentations, opiates, watery, farinaceous and mucilaginous fluids, turpentine clysters, and stimulating liniments to the region of the kidneys. If it proceed from a spasmodic affection, opium, æther, hyoscyamus, and the warm bath, are the proper remedies. When it arises from grumous blood, or pus, contained in the pelvis of the kidneys, we must promote the expulsion of them by the warm bath, diluents, opiates, and emollient laxative clysters. If it proceed from paralysis, internal and external stimulants, electricity, and the remedies recommended in the treatment of paralysis must be employed; and if from the last-mentioned cause, the most powerful means of removing such inflammations must be employed with diligence, and those means are pointed out in another place.

In ischury, from complaint in the bladder, there is a suppression of urine, accompanied with a circumscribed tumour of the hypogastrium, and a sense of distension in it, and an acute or obtuse pain about the neck of the bladder, attended with a frequent inclination to make water.

When the disease arises from the first-mentioned cause, it will be removed by blood-letting, laxatives, emollient laxative clysters, opiates, the warm bath, and friction of the hypogastrium, with a strong solution of camphor in olive oil, and if we do not succeed by those means, we must draw off the urine with the catheter; and in desperate cases have recourse to puncturing the bladder, either above the pubes, or by passing a trocar into it from the rectum. If the disease arise from schirrus of the prostrate gland, mercury, hemlock, sarsaparilla, and sea-bathing, should be recommended. If it be the consequence of paralysis, electricity, tincture of cantharides, and repeated small blisters will be proper. When it proceeds from spasm, opiates must be employed internally and externally, emollient laxative clysters, the warm bath, and a strong solution of the camphor; and if the patient be plethoric, it will be advisable to take away some blood. When the disease is caused by over-distention of the bladder, from the too long retention of the urine, cold substances must be applied to the hypogastric region, and cold water should afterwards be injected into the bladder. If induced by the presence of grumous blood, pus, or mucus, these are to be removed by tepid injections, diluents, and by the other means recommended in the treatment of the first species. If ectopia of the

bladder be the occasion of it, we must endeavour to bring the parts into their proper situation by the means adapted to their cause. If it arise from calculi, this will be discovered by there being an uneasy sensation at the orifice of the urethra after making water; sometimes a dull pain at the neck of the bladder, with a frequent desire of emptying the bladder, and the water often passing drop by drop, or the stream being suddenly interrupted; there will be also a considerable mucous sediment, and some degree of tenesmus, and the patient will generally void his urine when in a horizontal position. Under these circumstances, when the pain is considerable, two drachms of turpentine, incorporated with yolk of egg, and mixed with half a pint of gruel, with from sixty to a hundred drops of laudanum should be injected: costiveness must afterwards be obviated by rhubarb, combined with soap, or with small doses of calomel, or the saline cathartics: the uva ursi should be administered in doses of a scruple, or more, three times a day; and the dissolution of the calculus must be attempted by lithontriptics, as a drachm of the vegetable alkali, dissolved in a pint of water, supersaturated with carbonic acid gas, three times a day; Seltzer or soda water may be employed with advantage, or a large spoonful of a mixture composed of half an ounce of the aqua potassæ and six ounces and a half of the aqua calcis, in some mucilaginous liquor, may be given three times a day. When scybalæ in the rectum occasion the disease, injections of warm oil, or the internal employment of oil of almonds or castor, with laxative and emollient clysters, together with dashing the lower extremities with cold water, will generally succeed in promoting their evacuation. If it arise from flatus, we must employ essential oils and antispasmodics. If it be the consequence of an abscess, which will be discovered by the previous throbbing pain and nature of the discharge, after the bursting of the abscess, the frequent use of warm emollient and oily clysters will be necessary; and if it arise in consequence of the pressure of the gravid uterus, the urine must be drawn off by means of the catheter, until after delivery, when the complaint will cease of course.

Herpes, Tetters. This disease will be removed by the exhibition of some of the following remedies, sulphuric acid, tincture of cantharides, or black hellebore, or muriated mercury combined with tartar emetic and opium; Plummer's pill, or a solution of gamboge in spirit of ammonia, may be given; employing at the same time lime-water, or the decoction of guaiacum, sarsaparilla, or elder. The parts should be dressed with the unguentum nitratis hydrargyri, or with the sulphuric acid, mixed with eight times its quantity of pork lard; and we should at the same time employ the warm bath. The pulp of cassia, moistened with milk, and the cassia sophera of Linnæus, boiled in vinegar, are recommended upon good authority.

Tinea, Scald-head. This contagious eruption affects the whole of the hairy scalp, and is generally most virulent around the edges of the hair, on the back part of the head, often causing, by the acrimony of the discharge, swelling of the lymphatic glands of the neck. The first step necessary to be taken in the removal of this unpleasant complaint will be to shave the head close, after which it should be well fomented, and cloths moistened in a solution of liver of sulphur in lime-water, in the proportion of half an ounce of the former to a pint of the latter, should be constantly applied to the head; or tar-ointment may be employed, and the access of the air should be prevented by means of a bladder, properly fitted to the head; or a solution of sugar of lead, or of green or blue vitriol, may be tried, and the internal remedies recommended in the treatment of herpes should be employed. If we do not succeed by these means, blisters or an issue should be applied on the head, or the adjacent parts.

Psora, Itch. This consists of little watery pimples of a contagious nature, which first appear between the fingers and on the wrists; but in process of time spreading over the whole body, except the face, attended with a great degree of itchiness, especially when warm in bed, or exposed to the heat of a fire. This disease will most certainly be cured by the application of sulphur ointment, taking at the same time flour of sulphur. The unguentum calcis hydrargyri albi, or acidi sulphurici, or a solution of oxide of arsenic, or of muriated mercury, will also speedily remove it. The two last remedies should, however, be employed with much caution. A decoction of white hellebore is also a useful remedy. It may likewise be frequently cured by the exhibition of the sulphuric acid, in doses of from thirty to sixty drops, or more, two or three times a day, and to obviate its griping

it should be given in some mucilaginous fluid.

MEDIETAS *linguæ*, a jury or inquest impanelled, whereof the one half consists of natives or denizens, the other strangers, and is used in pleas, wherein the one party is a stranger, the other a denizen.

MEDIUM, in logic, the mean or middle term of a syllogism, being an argument, reason, or consideration, for which we affirm or deny any thing: or, it is the cause why the greater extreme is affirmed or denied of the less in the conclusion.

MEDIUM, in arithmetic, or *Arithmetical Medium*, or MEAN, called in the schools, medium rei, that which is equally distant from each extreme, or which exceeds the lesser extreme as much as it is exceeded by the greater, in respect of quantity not of proportion: thus 9 is a medium between 6 and 12. See PROPORTION.

MEDIUM, *geometrical*, called in the schools medium personæ, is that where the same ratio is preserved between the first and second, as between the second and third terms, or that which exceeds in the same ratio, or quota of itself, as it is exceeded: thus 6 is a geometrical medium between 4 and 9.

MEDIUM, in philosophy, that space or region through which a body in motion passes to any point; thus æther is supposed to be the medium through which the heavenly bodies move; air, the medium wherein bodies move near our earth; water, the medium wherein fishes live and move; and glass is also a medium of light, as it affords it a free passage. That density or consistence in the parts of the medium, whereby the motion of bodies in it is retarded, is called the resistance of the medium, which together with the force of gravity, is the cause of the cessation of the motion of projectiles.

MEDIUM, *subtle* or *æthereal*. Sir Isaac Newton makes it probable, that besides the particular ærial medium, wherein we live and breathe, there is another more universal one, which he calls an æthereal medium, vastly more rare, subtile, elastic, and active than air, and by that means, freely permeating the pores and interstices of all other mediums, and diffusing itself through the whole creation; and by the intervention hereof, he thinks it is, that most of the great phenomena of nature are effected. This medium he seems to have recourse to, as the first and most remote physical spring, and the ultimate of all natural causes. By the vibrations of this medium, he takes heat to be propagated from lucid bodies, and the intenseness of heat increased and preserved in hot bodies, and from them communicated to cold ones. By this medium, he takes light to be reflected, inflected, refracted, and put alternately in fits of easy reflection and transmission, which effects he elsewhere ascribes to attraction; so that this medium appears the source and cause even of attraction. Again, this medium being much rarer within the heavenly bodies than in the heavenly spaces, and growing denser as it recedes further from them, he supposes the cause of the gravitation of these bodies towards each other, and of the parts towards the bodies. Again from the vibrations of this same medium excited in the bottom of the eye, by the rays of light, and thence propagated through the capillaments of the optic nerves into the sensory, he takes vision to be performed; and so hearing from the vibrations of this or some other medium excited in the auditory nerves by the tremors of the air, and propagated through the capillaments of the nerves into the muscles; and thus contracting and dilating them.

The elastic force of this medium, he shews, must be prodigious. Light moves at the rate of 95,000,000 miles in about eight minutes, yet the vibrations and pulses of this medium, to cause the fits of easy reflection and easy transmission, must be swifter than light, which is 700,000 times swifter than sound. The elastic force of this medium therefore in proportion to its density must be above 490,000,000,000 times greater than the elastic force of the air in proportion to its density; the velocities and pulses of the elastic mediums, being in a subduplicate ratio of the elasticities and the rarities of the mediums taken together; and thus may the vibrations of this medium be conceived as the cause of the elasticity of bodies.

MEDULLA. See ANATOMY.

MEDUSA, in natural history, a genus of the Vermes Mollusca class and order. Body gelatinous, orbicular, and generally flat underneath; mouth central, beneath. There are forty-four species divided into two sections, viz. A. body with ciliate ribs. B. body smooth. The animals of this genus consist of a tender gelatinous mass of different figure, furnished with arms proceeding from the lower surface; the larger species, when touched, cause a slight tingling and redness, and are usually denominated

sea-nettles; they are supposed to constitute the chief food of cetaceous fish; and most of them shine with great splendour in the water.

MEERSCHAUM, in mineralogy, a species of the talc genus, is generally of a yellowish white colour; it occurs massive, internally it is dull; it adheres to the tongue, feels greasy, and the specific gravity is 1.6. It is infusible before the blow-pipe without addition. The constituent parts are,

Silica	41
Magnesia	18.25
Lime	0.5
Water, Carbonic acid	39.0
	98.75
Loss	1.25
	100.00

It is principally found in Natolia, in Lesser Asia; and the island of Samos: also in Greece, Hungary, and Moravia; in Spain and in some parts of America. It is chiefly used for the manufacture of tobacco-pipes. But the Turks use it as a medicine; they cover also the head and eyes of dead bodies with it, before burial. It is used in various parts of the Turkish dominions as fuller's earth is used here. It is distinguished from native talc earth by its colours, greater softness and less specific gravity; from lithomarge, by its colours and specific gravity; and from bole by its colours, want of lustre, and transparency.

MEESIA, in botany, a genus of the Cryptogamia Musci class and order. Generic character: capsule oblong; peristome double; outer with sixteen short blunt teeth; inner with as many sharp cilias, distinct or connected by net-work: males approaching the females, or discoid on a different plant.

MELALEUCA, in botany, a genus of the Polyadelphia Polyandria class and order. Natural order of Myrti, Jussieu. Essential character: calyx five-cleft, half superior; petals five; filaments many, very long, in five bodies; style one; capsule three-celled. There are eleven species, of which M. leucadendron, aromatic melaleuca is a tree with a black trunk and white branches, whence the name melaleuca; leaves quite entire, almost veinless, petioled; fructifications sessile, agglutinated, scattered below the leaves. It is a native of some parts of the East Indies and Cochin China; from it is distilled the green aromatic oil called cajeput, from caya puti, a white tree, which is the Malay name; the oil has the taste of peppermint, and a smell like turpentine; it seldom comes to Europe unadulterated; a decoction of the leaves is much used in Cochin China, as a tonic, &c. The bark is very serviceable in caulking boats and covering houses. M. hypericifolia, St. John's wort leaved melaleuca, is the most beautiful of the genus; it is plentiful in the English gardens, and was generally taken for an hypericum, till it produced its elegant flowers, which grow in a cylindrical form round the branches, having some resemblance to those of metrosideros lanceolata, commonly called citrina, occasioned by the radiated crimson filaments projecting in every direction; the claws of those filaments are very long, linear, and of a dull yellowish hue, like the petals. It grows in swampy grounds, in New South Wales.

MELAMPODIUM, in botany, a genus of the Syngenesia Polygamia Necessaria class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx five-leaved; receptacle chaffy, conical; down one-leafed, involuted, converging. There are three species, annuals, and natives of South America and the West Indies.

MELAMPYRUM, in botany, *cow-wheat*, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Pediculares, Jussieu. Essential character: calyx four-cleft; corolla upper lip compressed, with the edge folded back; capsule two-celled, oblique, opening on one side; seeds two, gibbous. There are five species, four of them are natives of Britain, growing spontaneously in corn-fields; they are all annuals.

MELANITE, in mineralogy, a species of the flint genus, is of a velvet black colour, inclining to greyish black. It occurs crystallized, and also in grains. In figure the crystals are six-sided prisms. Externally it is always smooth and shining, approaching to splendent. Internally it is shining, inclining to glistening. Specific gravity 3.7 to 3.8. It is composed of

Silica	35
Alumina	6
Lime	32
Oxide of iron	25
Manganese	2
	100

It has been found only at Frescati and St. Albano near Rome; in rocks belonging to the newest flœtz trap formation.

MELANTHIUM, in botany, a genus of the Hexandria Trigynia class and order. Natural order of Coronariæ Junci, Jussieu. Essential character: corolla six-petalled; filaments from the elongated claws of the corolla. There are ten species, of which M. virginicum, Virginian melanthium, has the flower stalks from six to eight inches high, branching at top into three or four divisions, with two or three linear leaves below the flowers; corolla of a dusky colour, rarely succeeded by seeds in England. Native of Virginia and several parts of North America.

MELASTOMA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Calycanthemæ. Melastomæ, Jussieu. Essential character: calyx five-cleft, bell-shaped; petals five, inserted into the calyx; berry five-celled, wrapped up in the calyx. There are sixty-seven species, of which M. acinodendron is a large tree, having many crooked branches, covered with a brown bark, and smooth entire leaves, above five inches long and two broad in the middle, with three deep veins running through them; both sides are of a light green, the edges are sharply indented, ending in acute points; the fruit grows in loose spikes at the ends of the branches, of a violet colour. Native of South America.

MELEAGRIS, in natural history, the *turkey*, a genus of birds of the order Gallinæ. Generic character: bill convex, short and strong; head and neck covered with spongy caruncles; chin with a longitudinal membranaceous caruncle; tail broad and expansile. Gmelin notices two species, and Latham five. The meleagris gallipavo, or wild turkey, is a native of America, the presumed origin of every species under the genus. In the northern parts of that continent these birds are found in flocks even of several hundreds, which, during the day-time, resort to the woods, feeding principally upon acorns, returning by night to some swampy grounds, where they roost upon the highest trees. In Carolina they occasionally grow to the weight of thirty, and even, it is said, forty pounds, and at Surinam they attain also a very considerable size. They are often taken by means of dogs, which, obliging them to run for a very considerable time, at length nearly exhaust their strength, and force them to take refuge in the tops of the tallest trees. Here, if within reach of the sportsman, they incur inevitable destruction, as the preceding exertions have occasioned so great a lassitude as to preclude all further effort; and they drop one after another, submitting without the slightest resistance to their fate. Turkeys breed only once in a year, but will produce a great number at a time, sometimes even so many as seventeen. The female sits with extreme closeness, and is very assiduous in maternal duties. The young, however, are very susceptible of injury, from almost innumerable causes, from cold and wet, and even sunshine itself, which, when powerful, has often been known to prove fatal to them. They are reared, therefore, in this country with great care and difficulty only, but in the counties of Suffolk and Norfolk, are nevertheless considered as a profitable appendage to almost every farming establishment. From these counties they are driven to the metropolis at certain seasons, and urged on the road by long sticks with bits of red cloth waving at the end of them, the sight of which excites in these birds uncommon terror. In their expressions of the strongest feelings, both of attachment and antipathy, they raise their train, and spread it nearly into a complete circle, uttering certain hollow and internal sounds, which produce a general agitation throughout the body. Collecting and displaying, in this manner, their whole dignity, they move with a slow and ostentatious step, desirous, as it were, to convince alike the objects of their love and hatred of their possessing superior power and consequence. See Aves, Plate VIII. fig. 8.

MELIA, in botany, *bead-tree*, a genus of the Decandria Monogynia class and order. Natural order of Trihilatæ. Meliæ, Jussieu. Essential character: calyx five-toothed; petals five; nectary cylindric, bearing the anthers at its mouth; drupe with a five-celled nucleus. There are three species, large trees, growing naturally in the East Indies.

MELIANTHUS, in botany, *honey-flower*, a genus of the Didynamia Angiospermia class and order. Natural order of Corydales. Rutaceæ, Jussieu. Essential character: calyx four-leaved, the lower leaf gibbous; petals four, with the nectary within the lowest; capsule five-celled. There are three species, natives of the Cape of Good Hope.

MELICA, in botany, *melic-grass*, a genus

of the Triandria Digynia class and order. Natural order of Gramina, Gramineæ or Grasses. Essential character: calyx two-valved, two-flowered, with the rudiment of one or two florets that are abortive, between the two others. There are fourteen species.

MELICOCCA, in botany, a genus of the Octandria Monogynia class and order. Natural order of Sapindi, Jussieu. Essential character: calyx four-parted; petals four, bent back below the calyx; stigma subpeltate; drupe or berry coriaceous. There is but one species, *viz.* M. bijuga, a middle sized tree with spreading branches; it is a native of South America, and cultivated both in the East and West Indies; it thrives well in the low lands about Kingston in Jamaica, sometimes rising to the height of eighteen feet or more; the fruit is mellow, growing to the size of a large plum.

MELICOPE, in botany, a genus of the Octandria Monogynia class and order. Essential character: calyx inferior, four-leaved; petals four; nectary glands four, twin; capsule four, one-seeded. There is but one species, *viz.* M. ternata, a native of New Zealand.

MELICYTUS, in botany, a genus of the Dioecia Pentandria class and order. Essential character: calyx five-toothed; corolla five-petalled, three times as long as the calyx; nectary five scales; male anthers five, without filaments, fastened to the inside of the nectary: female stigma flattened out, four or five lobed; capsule berried, one celled; seeds nestling. There is but one species, *viz.* M. ramiflorus, a native of New Zealand.

MELISSA, in botany, *baum* or *balm*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: calyx dry, flattish above; upper lip subfastigiate; corolla, upper lip somewhat arched, bifid; lower lip with the middle lobe heart-shaped There are six species, of which M. officinalis, common garden balm, has a perennial root and an annual stalk, which is square, branching from two to three feet high; leaves by pairs at each joint, two inches and a half long; the flowers grow in loose small bunches from the axils in whorls, upon single peduncles of a white or yellowish colour. Baum or balm is a native of the southern parts of Europe, especially in mountainous situations.

MELITTIS, in botany, *bastard baum*, a genus of the Didynamia Gimnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: calyx wider than the tube of the corolla; corolla, upper lip flat, lower crenated; anthers crosswise. There are two species, *viz.* M. melissophyllum, bastard baum, and M. japonica; the former has a perennial root, sending up three or four stems about a foot and a half in height; leaves opposite, petioled, elliptic, a little pointed; flowers large and handsome, growing principally on one side; peduncles round, hairy, and axillary; much honey is secreted from a gland that encircles the base of the germ, for which reason it is a favourite plant with bees. Native of several parts of Europe.

MELLATES, in chemistry, a genus of salts formed from the MELLITIC *acid*, which see.

MELLITE, or *honey-stone*, in mineralogy, takes its name from the yellow colour like that of honey. Its primitive figure is an octahedron, formed by four sided pyramids, the common base of which is a perfect square. The crystals are small, their surface is commonly smooth and shining. Internally it is splendent with a lustre between, vitreous and resinous. It is transparent, passing into the opaque, and possesses a double refraction. It is softer than amber and brittle. Specific gravity is from about 1.5 to 1.7. It becomes electric by friction, but continues so but a short time. From some experiments of Klaproth, the constituent parts of mellite are,

Silica	1.375
Iron	0.125
Alumina	14.5
Mellitic acid, Water, and Loss	84.
	100.

This mineral is not often to be met with; hitherto it has been found at Ætern in Thuringia; in the district of Saal; and in Switzerland. It occurs on bituminous wood, and earthy coal, and is commonly accompanied with sulphur.

MELLITIC *acid*, in chemistry, is procured from the substance just described, by the following process. The mineral is reduced to powder, and boiled with about 72 times its weight of water; the alumina is precipitated in the form of flakes, and the acid combines with the water. By filtration and evaporation, crystals are deposited, which are the crystals of mellitic acid, they

are in the form of fine needles, or in small short prisms with shining faces; they have a slightly acid taste, accompanied with some degree of bitterness. This acid is not very soluble in water; its constituent parts are carbon, hydrogen, and oxygen. The acid enters into combination with the earths, alkalies, and metallic oxides, and forms compounds denominated mellates.

MELOCHIA, in botany, a genus of the Monadelphia Pentandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: five-styled; capsule five-celled, one-seeded. There are eleven species, of which M. pyramidata, pyramidal melochia, is an elegant little plant about three feet in height, so slender and weak as generally to require some support; the umbels of flowers are usually placed pretty near, and each has five or six rays on a common peduncle; it is a native of Brazil and Jamaica.

MELODINUS, in botany, a genus of the Pentandria Digynia class and order. Natural order of Contortæ. Apocineæ, Jussieu. Essential character: contorted; nectary in the middle of the tube, stellate; berry two-celled, many-seeded. There is but one species, viz. M. scandens, a native of New Caledonia.

MELODY, in music, the agreeable effect of different sounds, ranged and disposed in succession; so that melody is the effect of a single voice or instrument, by which it is distinguished from harmony. See MUSIC.

MELOE, in natural history, a genus of insects of the order Coleoptera. Antennæ moniliform; thorax roundish; head inflected, gibbous; shells soft, flexile. Thirty-five species have been enumerated and described; these are separated into two divisions. A. without wings; shells abbreviated. B. winged; shells as long as the abdomen. The latter division is again divided into those that have horny jaws, bifid; and those with a linear jaw, entire. Of the species we may notice M. proscarabœus, or oil-beetle, which is entirely blue-black or dark violet; it is found in the advanced state of spring in fields and pastures, creeping slowly, the body appearing so distended with eggs, as to cause the insect to move with difficulty. On being roughly touched it suddenly exudes a yellowish moisture from the pores, of a yellow colour, and of a very penetrating and peculiar smell. The female of this species deposits her eggs in a heap beneath the surface of the ground; from these are hatched the larvæ, which find subsistence by attaching themselves to other insects, and absorbing their juices. M. vesicatorious, blister-fly, or Spanish fly, is, as its name imports, found chiefly in Spain. This is an insect of very great beauty, being entirely of the richest gilded grass-green, with black antennæ. This is the famous cantharis of the shops, the safest and most efficacious blister-plaster.

MELON, in botany, is accounted only a species of cucumber. See CUCUMIS.

MELOTHRIA, in botany, a genus of the Triandria Monogynia class and order. Natural order of Cucurbitaceæ. Essential character: calyx five-cleft; corolla bell-shaped, one-petalled; berry three-celled, many-seeded. There is but one species, viz. M. pendula, a plant growing wild in the woods in Carolina and Virginia; it creeps upon the ground with slender vines, having angular leaves, resembling those of the melon; the fruit, in the West Indies, grows to the size of a pea of an oval figure, changing black when ripe; the inhabitants pickle them green.

MELYRIS, in natural history, a genus of insects of the order Coleoptera. Antennæ entirely perfoliate; head inflected under the thorax; thorax margined; lip clavate, emarginate; jaw one-toothed, pinnate. There are three species, viz. the viridis, the niger, and the lineatus.

MEMBER, in architecture, denotes any part of a building; as a frieze, corniche, or the like. This word is also sometimes used for the moulding. See MOULDING.

MEMBRANE, in anatomy, a pliable texture of fibres, interwoven together in the same plane.

MEMECYLON, in botany, a genus of the Octandria Monogynia class and order. Natural order of Calycifloræ. Onagræ, Jussieu. Essential character: calyx superior, with a striated base and the margin quite entire; corolla one-petalled; anthers inserted into the side of the apex of the filament; berry crowned with a cylindrical calyx. There are four species, natives of warm climates.

MEMORY, a faculty of the human mind, whereby it retains or keeps the ideas it has once perceived.

Memory, says Mr. Locke, is, as it were, the store-house of our ideas; for the narrow mind of man not being capable of having many ideas under view at once, it was necessary to have a repository in which to lay up those ideas which it may afterwards have use of. But our ideas being nothing but actual perceptions in the mind, which

cease to be any thing when there is no perception of them; this laying up of our ideas in the repository of the memory, signifies no more than this; that the mind has a power, in many cases, to revive perceptions it has once had, with this additional perception annexed to them, that it has had them before. And it is by the assistance of this faculty, that we are said to have all those ideas in our understandings which we can bring in sight, and make the objects of our thoughts, without the help of those sensible qualities which first imprinted them there.

Attention and repetition help much to the fixing ideas in our memories: but those which make the deepest and most lasting impressions, are those which are accompanied with pleasure and pain. Ideas but once taken in and never again repeated, are soon lost; as those of colours in such as lost their sight when very young.

The memory of some men is tenacious almost to a miracle; but yet there seems to be a constant decay of all our ideas, even of those which are struck deepest; and in minds the most retentive; so that if they be not sometimes renewed, the print wears out, and at last there remains nothing to be seen.

Those ideas that are often refreshed by a frequent return of the objects or actions that produce them, fix themselves best in the memory, and remain longest there: such are the original qualities of bodies, *viz.* solidity, extension, figure, motion, &c. and those that almost constantly affect us, as heat and cold.

In memory, the mind is oftentimes more than barely passive; for it often sets itself on work to search some hidden ideas; sometimes they start of their own accord; and sometimes tempestuous passions tumble them out of their cells. This faculty other animals seem to have to a great degree, as well as men, as appears by birds learning of tunes, and their endeavour to hit the notes right. For it seems impossible that they should endeavour to conform their voices (as it is plain they do) to notes whereof they have no idea.

MEMORY, *local*, among orators, is nothing but the associating the different heads to be handled, with the objects before the speaker's eyes; so that by only looking around him, he is put in mind of what he is to say.

MEMORY, *artificial*, *Memoria Technica*, a method of assisting the memory, by forming certain words, the letters of which shall signify the date or æra to be remembered. In order to this, the following series of vowels, diphthongs, and consonants, together with their corresponding numbers, must be exactly learned; so as to be able at pleasure to form a technical word, that shall stand for any number, or to resolve such a word already formed.

a	*e*	*i*	*o*	*u*	*au*	*oi*	*ei*	*ou*	*y*
1	2	3	4	5	6	7	8	9	0
b	*d*	*t*	*f*	*l*	*s*	*p*	*k*	*n*	*z*

The first five vowels, in order, naturally represent 1, 2, 3, 4, 5; the diphthong *au* = 6, as being composed of *a* and *u*, or 1 + 5 = 6; and for the like reason, *oi* = 7, and *ou* = 9. The diphthong *ei* will easily be remembered for 8, as being the initials of the word. In like manner, where the initial consonants could conveniently be retained, they are made use of to signify the number, as *t* for 3, *f* for 4, *s* for 6, and *n* for 9. The rest were assigned without any particular reason, unless that possibly *p* may be more easily remembered for 7, or septem; *k* for 8, or οκτω; *d* for 2, or duo; *b* for 1, as being the first consonant; and *l* for 5, being the Roman letter for 50; than any others that could have been put in their places.

It is further to be observed, that *z* and *y* being made use of to represent the cypher, where many cyphers meet together, as 1,000, 1,000,000, &c. instead of a repitition of *a z y z y z y*, &c. let *g* stand for 100, *th* for a thousand, and *m* for a million. Thus *ag* will be 100, *ig* 300, *oug* 900, &c.; *ath* 1,000, *am* 1,000,000, *loum* 59,000,000, &c.

Fractions may be set down in the following manner: let *r* signify the line separating the numerator and denominator, the first coming *before*, the other *after* it; as *iro* $\frac{3}{4}$, *urp* $\frac{5}{7}$, *pourag* $\frac{79}{100}$, &c. When the numerator is 1, or unit, it need not be expressed, but begin the fraction with *r*: as *re* $\frac{1}{2}$, *ri* $\frac{1}{3}$, *ro* $\frac{1}{4}$, &c. So in decimals, *rag* $\frac{1}{100}$, *rath* $\frac{1}{1000}$.

This is the principal part of the method, which consists in expressing numbers by artificial words. The application to history and chronology is also performed by artificial words. The art herein consists in making such a change in the ending of the name of a place, person, planet, coin, &c. without altering the beginning of it, as shall readily suggest the thing sought, at the same time that the beginning of the word, being preserved, shall be a leading or prompting syllable to the ending of it so changed.

Thus, in order to remember the years in which Cyrus, Alexander, and Julius Cæsar, founded their respective monarchies, the following words may be formed; for Cyrus, Cyr*uts*; for Alexander, Alex*ita*; for Julius Cæsar, Juli*os*. *Uts* signifies, according to the powers assigned to the letters before-mentioned, 536; *ita* is 331, and *os* is 46. Hence it will be easy to remember, that the empire of Cyrus was founded 536 years before Christ, that of Alexander, 331, and that of Julius Cæsar, 46. This account is taken from a treatise, entitled, "A New Method of Artificial Memory;" where the reader will find several examples in chronology, geography, &c. of such artificial words disposed in verses, which must be allowed to contribute much to the assistance of the memory, since, being once learned, they are seldom or never forgot. However, the author advises his reader to form the words and verses himself, in the manner described above, as he will probably remember these better than those formed by another.

Be this as it will, we shall here give his table of the Kings of England since the Conquest; where one thousand being added to the italics in each word, expresses the year when they began their reigns. Thus,

Will-cons*au*, Ruf*koi*, Hen*rag*.
Steph*bil* & Hensec*buf*, Rich*bein*, J*ann*, Heth*das*, & Ed*doid*.
Edse*typ*, Edter*tes*, Rise*toip*, Hef*o*t*oun*, Hen*sfad*que.
Hensi*fed*, Edquar*foiz*, Efi Ro*kt*, Hensep*fell*, Heno*clyn*.
Edsex*les*, Mary*lut*, Els*luk*, Jam*syd*, Caroprim*sel*.
Carsec*sok*, Jame*if*, Wil*seik*, An*pyb*, Geo*be-doi-sy*.

MENACHINITE, in mineralogy, a species of the Titanium genus, is of a greyish black colour, inclining to iron-black; it occurs only in very small flattish angular grains, which have a rough, glimmering surface; internally it is glistening; specific gravity 4.2 to 4.5. It is attractable by the magnet, but in a much weaker degree than iron sand, or magnetic iron stone. Without addition, it is infusible before the blowpipe; it tinges borax of a greenish colour, which inclines to brown: according to Klaproth the constituent parts are

Magnetic oxide of iron	51
Oxide of menachine	45.25
Oxide of manganese	0.25
Silica	3.50
	100.00

This mineral is found accompanied by fine quartz sand, in the bed of a rivulet which enters the valley of Manachan in Cornwall; also on the shores of the island of Providence in America; and at Botany Bay: it is distinguished from iron-sand by the fracture, lustre, and inferior hardness.

MENAIS, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Borragineæ, Jussieu. Essential character: calyx three-leaved; corolla salver-shaped; berry four-celled; seeds solitary. There is but one species, *viz.* M. topiaria, a native of South America.

MENILITE, in mineralogy, is of a chesnut-brown colour, inclining to liver-brown: externally, it is marked with narrow stripes of reddish brown and pearl-grey, which alternate with each other. It occurs in tuberose imbedded masses, the surface of which is smooth and ribbed, and sometimes covered with a white crust. It is found in adhesive slate, at Menil Montagne, near Paris: the constituents are,

Silica	85.50
Alumina	1
Oxide of iron	0.50
Calcareous earth	0.50
Water and carbonaceous matter	11.00
	18.50
Loss	1.5
	100

MENISCIUM, in botany, a genus of the Cryptogamia Filices, or Ferns. Generic character: capsules heaped in crescents, interposed between the veins of the frond. There is but one species, *viz.* M. reticulatum, a native of Martinico, Brazil, &c.

MENISCUS, in optics, a lens convex on one side, and concave on the other. See Lens. For finding the focus of a meniscus, the rule is: as the difference of the semidiameters of the concavity and convexity, to the semidiameter of the concavity; so is the diameter of the convexity to the focal distance.

MENISPERMUM, in botany, *moonseed*, a genus of the Dioecia Dodecandria class and order. Natural order of Sarmentaceæ. Menisperma, Jussieu. Essential character: male petals, four outer; eight inner; stamina sixteen: female, corolla as in the male; stamina eight, barren; berries two, one-seeded. There are thirteen species.

MENSURATION is the art of ascertaining the contents of superficial areas, or

planes; of solids, or substantial objects; and the lengths, breadths, &c. of various figures; either collectively or abstractedly. The mensuration of a plane superficies, or surface, lying level between its several boundaries, is easy: when the figure is regular, such as a square, or a parallelogram, the height, multiplied by the breadth, will give the superficial contents. Thus, if a table be 5 feet 2 inches in length, by 4 feet 1 inch in breadth, multiply 62, (the number of inches in 5 feet 2 inches) by 49, (the number of inches in 4 feet 1 inch), the result will shew the number of square inches; which, being divided by 144, (the number of square inches in a square foot), will exhibit the number of square feet on the surface of the table. Whatever balance may remain, may either be left as fractional, or hundred and forty-fourth parts; or, being divided by 36, may be made to show the numbers of quarters of square feet, beyond the integers produced by the first division.

For instance, multiply 62 inches
by 49 inches
558
248 f
Divide by 144) 3038 (21 : $\frac{14}{144}$
288
158
144
14

In regard to triangles, their bases multiplied by half their heights, or their heights by half their bases, will give the superficial measure. But it is necessary to caution our readers not to measure by the oblique line of a triangle, considering it as the altitude: a reference to the article GEOMETRY will show, that the height of a triangle is taken by means of a perpendicular to the base, limited by a parallel to the latter, which exactly includes the apex, or summit.

Any rectilinear figure may have its surface estimated, however numerous the sides may be; simply dividing it into triangles, by drawing lines from one angle to another, but taking care that no cross lines be made: thus, if a triangle should be equally subdivided, it may be done by one line, which must, however, be drawn from any one point to the centre of the opposite face. A four-sided figure will be divided into two triangles, by one oblique line connecting the two opposite angles: a five-sided figure (or pentagon) by two lines, cutting as it were one triangle out of the middle, and making one on each side: a six-sided figure (or hexagon) will require three diagonals, which will make four triangles; and so on to any extent, and however long, or short, the several sides may be respectively.

With respect to the form and properties of various figures, we refer our readers to the head of GEOMETRY, where all that relates thereto is pointed out, and the commutations they undergo, when their contents or areas are measured, will be distinctly seen.

The most essential figure is the circle, of which mathematicians conceive it impossible to ascertain the area with perfect precision, except by the aid of logarithmic and algebraic demonstration. It may be sufficient in this place to state, that 8 $\frac{10}{17}$ of the diameter, will give the side of a square, whose area will be correspondent with that of a circle having 10 for its diameter. Therefore as the diameter may be easily divided, either arithmetically, or mechanically, into ten equal parts, and one of those parts into seventeen; by taking 8 integers, and 10 of the 17th portions, the side of such a square may be easily demonstrated. Where a circle is small, its scale may be extended by an oblique line, which may be made to any extent, as shewn in the fig. 7, Plate X. Miscel. where A B is the diameter of a circle, and A C the oblique line, lying between the perpendiculars that would fall on A B. If A C be divided into any number of parts, perpendiculars drawn from A B to the points of division, as *a b*, *c d*, will divide the diameter exactly, in the same proportions as A C is divided. The radius, or semidiameter, of a circle also gives us the means of forming a square corresponding with its area. Having drawn the whole diameter, A B, fig. 8, take the radius, C B, and set it off from B to D; from which measure another radius, at right angles with C B, to wherever it may fall, *i. e.* at E, on the diameter: the hypothenuse, B E, will give the side of the square sought.

We have been particular in describing this process, because so many circular or cylindrical figures come under the measurer's consideration; whether they be mirrors, arched passages, columns, &c. The contents of a pillar are easily ascertained, even though its diameter may be perpetually varying; for if we take the diameter in different parts, and strike a mean between every two adjoining measurements, and multiply that mean area by the depth, or

interval between the two, the solid contents will be found.

The contents of pyramids are measured by multiplying the areas of their bases by half their lengths; or their lengths by half the areas of their bases. Cones, whose sides are straight, are equal to one-third the solid contents of cylinders, equal to them in base and altitude.

Solids, which have a certain degree of regularity, may be easily measured: thus a cube is computed by multiplying first its width by its length; then their sum by its height: thus a cube, measuring four feet each way, would be $4 \times 4 = 16 \times 4 = 64$. This is the meaning of what is called the cube root: see CUBIC NUMBER. Parallelopipedons, or solids of a long form, such as squared timbers, are measured by the same means: say that a timber be seven feet long, and at its ends be six inches by four. The area of either end, which is here considered as the base, will give 24 square inches, which multiplied by 84 (the number of inches in 7 feet) will show 2,016 solid inches. Divide by 1728, (the number of solid inches in a solid foot), and the result will be 1 foot 288 solid inches. But we have a shorter way, when, as in the above instance, the parts are regular multiples; for 6 by 4 is the sixth part of a superficial foot; consequently six feet in length of such a beam answers to one foot cube, and the remainder will shew the sixth part of a foot cube: so that we may indicate the amount, either as above, or by calling it 1 solid foot and ⅙. For the mensuration of growing timber, various modes have been offered; but we know of none more simple than that invented by Captain Williamson, and exemplified in his "Mathematics Simplified."

His practice has been to fix a short batten, at exactly 45 degrees, angular with a staff of about 5¼ feet long; the latter being armed with a spike to fix it in the soil, and having a plumb line at one corner. When a sight taken along the batten, (the staff being exactly perpendicular), points to the highest part of a tree, that is of the main trunk, measure the distance from the place where the staff is fixed to the place where the tree stands: the intermediate distance, added to the length of the staff, will show the height to which the timber is marketable. For it is evident, that, as an angle of 45 degrees gives equal base and perpendicular, so must the altitude correspondent with the distance between the junction of the batten with the staff to the tree, and a perpendicular from the part cut on the tree, by the line of sight, to the level of that junction: the length of the staff must correspond with the length of stem below that level. We beg leave to refer our readers to the publication above-quoted for further particulars on this head, as well as for numerous useful hints in regard to surveying in general. See fig. 9.

After a tree has been felled, its girth is usually taken at each end, and at the middle: when there is no particular swell, or that the top extremity does not suddenly decrease, this rule may answer well; but where the irregularity is great, it is better to take many more girths, and summing up the whole, to divide their amount by the number of girths taken; so as to establish a mean measurement. Divide that mean measurement by 4, to find the side of a square to which the tree will be reduced when prepared for the sawyer. If the whole solid contents are to be estimated, divide by 3, instead of by 4, and taking the third part, thus given, for a diameter, act upon it as already shown, to find the side of a square, equal to the circle of which that ascertained third part is the diameter.

The greatest portion of mensuration appertains to the contents of solid bodies, or areas, such as hay-stacks, interiors of barns, granaries, &c.; all of which come under the rule laid down for cubes, &c. When any sides fall in regularly, as in garrets, &c. the inclined part must be treated as a pyramid, or as a quoin, (or wedge), and the whole be summed up together. The contents of casks, tubs, &c. are treated of under the head of GAUGING, (which see), and that part of our subject which appertains to the admeasurement of lands, as also to the distances, heights, &c. of remote objects, accessible or otherwise, will be found under the head of SURVEYING.

MENTHA, in botany, *mint*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ or Labiatæ. Essential character: corolla almost equal, four-cleft, the broader segment emarginate: stamina upright, distant. There are nineteen species. M. viridis, spearmint, possesses a more agreeable flavour than most of the others: it is generally preferred for culinary, and some medicinal purposes: this herb contains a good deal of essential oil, as do all the other mints; but of a much less agreeable odour than that of

lavender or marjoram. It is a native of several parts of Europe.

MENTZELIA, in botany, so named from Christian Mentzelius, Physician to the Elector of Brandenburgh; a genus of the Polyandria Monogynia class and order. Natural order of Calycanthemæ. Onagræ, Jussieu. Essential character: calyx five-leaved; corolla five-petalled; capsule inferior, cylindric, many-seeded. There is but one species, viz. M. aspera, an annual plant, native of America.

MENYANTHES, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Preciæ. Lysimachiæ, Jussieu. Essential character: corolla shaggy; stigma bifid; capsule one-celled. There are five species, of which M. nymphoides, fringed buckbean, or water-lily, has a long, stringy, perennial root, the stems are round, smooth, and jointed, producing opposite thick leaves, floating on the surface of the water, on foot-stalks various in length, according to the depth of the stream; the flowers grow from the axils in a kind of sessile umbel, four or five together, on long round peduncles, shorter than the petioles; when expanded in the sun they have a brilliant appearance. It is a native of Denmark, Holland, Germany, Piedmont, and England, growing in ditches and slow streams; it flowers from June to August.

MERCHANT, a person who buys and sells commodities in gross, or deals in exchanges; or that traffics in the way of commerce, either by importation or exportation. Formerly every one who was a buyer or seller in the retail way was called a merchant, as they are still both in France and Holland: but here, shopkeepers, or those who attend fairs or markets, have lost that appellation.

Previously to a person's engaging in a general trade, and becoming an universal dealer, he ought to treasure up such a fund of useful knowledge as will enable him to carry it on with ease to himself, and without risking such losses as great, ill-concerted undertakings would naturally expose him to. A merchant should therefore be acquainted with the following parts of commercial learning: 1. He should write properly and correctly. 2. Understand all the rules of arithmetic that have any relation to commerce. 3. Know how to keep books of double and single entry, as journals, a ledger, &c. 4. Be expert in the forms of invoices, accounts of sales, policies of insurance, charter-parties, bills of lading, and bills of exchange. 5. Know the agreement between the money, weights, and measures of all parts. 6. If he deals in silk, woollen, linen, or hair manufactures, he ought to know the places where the different sorts of merchandizes are manufactured, in what manner they are made, what are the materials of which they are composed, and from whence they come, the preparations of these materials before working up, and the places to which they are sent after their fabrication. 7. He ought to know the lengths and breadths which silk, woollen, or hair-stuffs, linen, cottons, fustians, &c. ought to have, according to the several statutes and regulations of the places where they are manufactured, with their different prices, according to the times and seasons; and if he can add to his knowledge the different dyes and ingredients which form the various colours, it will not be useless. 8. If he confines his trade to that of oils, wines, &c. he ought to inform himself particularly of the appearances of the succeeding crops, in order to regulate his disposing of what he has on hand; and to learn as exactly as he can, what they have produced when got in, for his direction in making the necessary purchases and engagements. 9. He ought to be acquainted with the sorts of merchandise found more in one country than another, those which are scarce, their different species and qualities, and the properest method for bringing them to a good market, either by land or sea. 10. To know which are the merchandizes permitted or prohibited, as well on entering as going out of the kingdoms or states where they are made. 11. To be acquainted with the price of exchange, according to the course of different places, and what is the cause of its rise and fall. 12. To know the customs due on importation or exportation of merchandizes, according to the usage, the tarifs, and regulations of the places to which he trades. 13. To know the best manner of folding up, embaling, or tunning the merchandizes, for their preservation. 14. To understand the price and condition of freighting, and insuring ships and merchandize. 15. To be acquainted with the goodness and value of all necessaries for the construction and repairs of shipping, the different manner of their building, what the wood, the masts, cordage, cannons, sails, and all requisites may cost. 16. To know the wages commonly given to the captains, officers, and sailors, and the manner of engaging with them. 17. He ought to understand the fo-

reign languages, or at least as many of them as he can attain to; these may be reduced to four, viz. the Spanish, which is used not only in Spain, but on the coast of Africa, from the Canaries to the Cape of Good Hope: the Italian, which is understood on all the coasts of the Mediterranean, and in many parts of the Levant: the German, which is understood in almost all the northern countries; and the French, which is now become almost universally current. 18. He ought to be acquainted with the consular jurisdiction, with the laws, customs, and usages of the different countries he does or may trade to; and in general all the ordinances and regulations, both at home and abroad, that have any relation to commerce. 19. Though it is not necessary for a merchant to be very learned, it is proper that he should know something of history, particularly that of his own country, geography, hydrography, or the science of navigation, and that he is acquainted with the discoveries of the countries in which trade is established, in what manner it is settled, of the companies formed to support those establishments, and of the colonies they have sent out.

All these branches of knowledge are of great service to a merchant who carries on an extensive commerce; but if his trade and his views are more limited, his learning and knowledge may be so too: but a material requisite for forming a merchant is, his having on all occasions a strict regard to truth, and his avoiding fraud and deceit, as corroding cankers that must inevitably destroy his reputation and fortune.

Trade is a thing of so universal a nature, that it is impossible for the laws of England, or of any other nation, to determine all the affairs relating to it; therefore all nations, as well as Great Britain, shew a particular regard to the law merchant, which is a law made by the merchants among themselves: however, merchants and other strangers are subject to the laws of the country in which they reside. Foreign merchants are to sell their merchandize at the port where they land, in gross, and not by retail; and they are allowed to be paid in gold or silver bullion, in foreign coin or jewels, which may be exported. If a difference arises between the King and any foreign state, the merchants of that state are 'allowed six months' time to sell their effects and leave the kingdom, during which time they are to remain free and unmolested in their persons and goods.

MERCHANT. The law of merchants is part of the common law of England. See INSURANCE, BILLS OF EXCHANGE.

MERCURIALIS, in botany, *mercury*, a genus of the Dioecia Enneandria class and order. Natural order of Tricoccæ. Euphorbiæ, Jussieu. Essential character: male, calyx three-parted; corolla none; stamina nine or twelve; anthers globular, twin: female, calyx three-parted; corolla none; styles two; capsule dicoccous, two-celled, one seeded. There are six species.

MERCURY, a metal which has long been distinguished, as the only one that retains its fluidity at the common temperature of the atmosphere. The late discoveries of Mr. Davy have, however, produced two others which possess this property: these will be noticed in their places: see SODAIUM, and POTASSIUM; see also ALKALI. When the temperature is reduced to about 40° below zero of Fahrenheit, it assumes a solid form: this however is a degree of cold that never occurs but in high northern latitudes, and in this country mercury can only be exhibited in a solid state by artificial means: see COLD. When congealed, its specific gravity is so much increased, that it sinks to the bottom of the fluid mass. It has been increased from 13.5 to 15.6. At about 600° of Fahrenheit, it boils and is changed into vapour, and this method is taken to purify it from the admixture of other metals. When very pure, mercury is not oxydized at the common temperature of the atmosphere, but may be converted into an oxide by boiling. It is dissolved by hot sulphuric acid, and forms a white salt, which, being washed with boiling water, produces a yellow substance called turbith mineral. It may likewise be dissolved by nitric acid with and without heat; but the mercury is more highly charged with oxygen in the former case than in the latter. It may be united to the muriatic acid by a double elective affinity: thus when sulphate of mercury and muriate of soda, both dry, are mixed and exposed to heat, a combination of oxide of mercury and muriatic acid is obtained by sublimation: this is called in the shops "corrosive sublimate." "Calomel" is compounded of the same substances, but with a larger proportion of mercury. Corrosive muriate of mercury is in the form of a white compact mass, tending to a crystalline arrangement: it is soluble in about twenty parts of water, at the temperature of 60°, and in two parts of boiling water. In alcohol

much larger portions are dissolved. The taste of this salt is styptic and disagreeable, and it acts as a most virulent poison, so that although it is used in medicine, it cannot be administered in larger quantities than the sixth or eighth of a grain. The oxide which exists in the corrosive muriate of mercury, consists of

Mercury	85
Oxygen	15
	100

In the muriate there are

Oxide	82
Acid	18
	100

Therefore 100 parts of the muriate consist of

Mercury	67
Oxygen	12.3

forming eighty-two parts of oxide, with which eighteen parts of muriatic acid are combined.

The oxides of mercury are all reduced by heat alone, without the addition of any combustible substance, and afford oxygen gas. Mercury itself dissolves gold, silver, tin, and other metals, and if properly combined with it in sufficient quantity, the mercury loses its fluidity, and forms an amalgam. It is observed, that a solid amalgam of lead, and another of bismuth, have the property of becoming fluid. By combination with sulphur, mercury affords two compounds. By long trituration, these bodies unite, and form a black sulphuret. When united by fusion, and afterwards sublimed, a red sulphuret is produced, called cinnabar, which, being reduced to powder, affords the common pigment vermillion.

Mercury is the basis of a new fulminating compound. The oxides precipitated from their combinations with acids, by the alkalies or earths, especially by ammonia or lime, are capable, when combined with sulphur, of detonating. If triturated with one-sixth part of their weight of sulphur, on being exposed gradually to heat they explode with considerable force. These materials must be prepared and dried in the open air, and exposed to the light. Mr. Howard has discovered another fulminating powder of mercury, possessed of still greater powers. This is prepared by dissolving 100 grains of mercury in one ounce and a half of nitric acid: the solution, when cold, is to be poured upon two ounces of alcohol: a moderate heat is then to be applied, till an effervescence is excited, when a precipitate is formed, which is to be immediately collected on a filter, well washed with distilled water, and carefully dried in a heat not much exceeding that of a water-bath. From 100 grains of mercury, between 120 and 130 grains of dry precipitate are formed. This preparation fulminates very strongly. If two or three grains only be laid on an anvil, and struck smartly with a hammer, it explodes with a loud report. Four grains will occasion indentation in the hammer and anvil. This powder is found to consist of oxide of mercury, combined with oxalic acid and nitrous etherized gas. The two latter being produced during its formation, by the action of the nitric acid on the alcohol. Its explosion and force are supposed to be owing to the oxygen present suddenly combining with the carbon and hydrogen, forming watery vapour and carbonic acid: azotic gas is also discharged, and much caloric is evolved, so as to volatilize the mercury: to this, the conversion of the mercury into vapour, Mr. Howard ascribes its great explosive force.

We have observed, that mercury unites with many of the metals: from this property it is used to separate gold and silver from the substances with which they are mixed. It is thus capable of extracting the hundred-thousandth part of its weight of gold. In gilding and silvering, it is, from the same property, the medium of union between the gold or silver, and the metal on which the operation is performed. Hence mercury is of extensive use in the arts: its amalgam, with tin, is used in silvering mirrors, and in electrical experiments. Its importance in the structure of the common barometer is well known; and the uniformity of its expansion at various degrees of heat, has shewn it to be the best fluid for thermometers.

Mercury, in astronomy, is a small star that emits a very bright white light: though, by reason of his always keeping near the sun, he is seldom to be seen; and when he does make his appearance, his motion towards the sun is so swift, that he can only be discerned for a short time. He appears a little after sunset, and again a little before sunrise. Mercury never goes to a greater distance from the sun than about 27° 5′; so that he is never longer in setting after the sun than an hour and fifty minutes; nor does he ever rise sooner than one hour and fifty minutes before that lu-

minary. Very frequently, he goes so near the sun as to be lost altogether in his rays. When he begins to make his appearance in the evening after sunset, he can scarcely at first be distinguished in the rays of the twilight. But the planet disengages itself more and more, and is seen at a greater distance from the sun every successive evening; and having got to the distance of about 22° 5′, it begins to return again. During this interval, the motion of Mercury, referred to the stars, is direct; but when it approaches within 18° of the sun, it appears for some time stationary; and then its motion begins to be retrograde. The planet continues to approach the sun, and at last plunges into his rays in the evening, and disappears. Soon after, it may be perceived in the morning, before sunrise, separating further and further from the sun, his motion being retrograde as before he disappeared. At the distance of 18° it becomes stationary, and assumes a direct motion, continuing, however, to separate, till it comes to 22°.5 of distance; then it returns again to the sun, plunges into his rays, and appears soon after in the evening, after sunset, to repeat the same career. The angular distance from the sun, which the planet reaches on both sides of that luminary, varies from 16° to nearly 28°. The duration of a complete oscillation, or the interval of time that elapses before the planet returns again to the point from which it set out, varies also from 100 to 130 days. The mean arc of his retrogradation is about 13½°; its mean duration twenty-three days; but the quantity differs greatly in different retrogradations. In general, the laws of the movements of Mercury are very complicated; he does not move exactly in the plane of the ecliptic; sometimes he deviates from it more than 5°. Some considerable time must have elapsed before astronomers suspected that the stars which were seen approaching the sun in the evening and in the morning were one and the same. The circumstance, however, of the one never being seen at the same time with the other, would gradually lead them to the right conclusion. The apparent diameter of Mercury varies as well as that of the sun and moon, and this variation is obviously connected with his position relatively to the sun, and with the direction of his movement. The diameter is at its minimum when the planet plunges into the solar rays in the morning, or when it disengages itself from them: it is at its maximum when the planet plunges into the solar rays in the evening, or when it disengages itself from them in the evening; that is to say, when the planet passes the sun in its retrograde motion, its diameter is the greatest possible; when it passes the sun in its direct motion, it is the smallest possible; and the mean length of the apparent diameter of Mercury is 11″. Sometimes, when the planet disappears during its retrograde motion, that is to say, when it plunges into the sun's rays in the evening, it may be seen crossing the sun under the form of a black spot, which describes a chord along the disk of the sun. This black spot is recognized to be the planet, by its position, its apparent diameter, and its retrograde motion. These transits of Mercury, as they are termed, are real annular eclipses of the sun: they demonstrate that the planet is an opaque body, and that it borrows its light from the sun. When examined by means of telescopes, magnifying about 200 or 300 times, he appears equally luminous throughout his whole surface, without the least dark spot. But he exhibits the same difference of phases with the moon, being sometimes horned, sometimes gibbous, and sometimes shining almost with a round face, though not entirely full, because his enlightened side is never turned directly towards us; but at all times perfectly well defined without any ragged edge, and perfectly bright. Like the moon, the crescent is always turned towards the sun. These different phases throw considerable light on the orbit of Mercury. See Venus.

Mercury, in heraldry, a term used, in blazoning by planets, for the purple colour in the arms of sovereign princes. See Blazoning.

MERGER, in law, is where a less estate in lands, &c. is drowned in the greater; as if the fee come to the tenant for years or life, the particular estates are merged in the fee; but an estate tail cannot be merged in an estate in fee; for no estate in tail can be extinct by the accession of a greater estate to it.

MERGUS, in natural history, the *Merganser*, a genus of birds of the order Anseres. Generic character: bill serrated, slender, and hooked at the point; nostrils small, oval, and near the middle of the bill; feet four-toed, the outer one before longer than the middle one. There are ten species, of which we shall notice the following. M. merganser, the goosander, weighs about four pounds, and is twenty-eight inches

long. It is common in the northern regions of Europe and Asia, and is found in the Orknies during the whole year. It builds sometimes on trees, but generally in the holes and fissures of rocks, and feeds on fish. Its flesh is strong, and seldom applied for food. See Aves, Plate IX. fig. 5. The M. serrator, or red-breasted goosander, is considerably less than the former, is found also in the same latitudes, and breeds in the north of Scotland, particularly in Loch Mari, in the county of Ross. It dives excellently, and is extremely alert on the water. About the season of its moulting, however, the natives of Greenland often kill it by darts, as the birds are less active than usual in that state of weakness, and suffer the enemy to approach more nearly than at other times. These birds, like the former, and indeed the other species of the genus, subsist in a great degree on fish. They fly near the surface of the water, with great apparent vigour, though seldom to any great distance. Their sharp, serrated, and hooked bills are admirably adapted to secure their prey, which is scarcely ever observed, notwithstanding all its lubricity, to elude their grasp. See Aves, Plate IX. fig. 4. For the Smew, see Aves, Plate IX. fig. 6.

MERIDIAN, in astronomy, a great circle passing through the poles of the world, and both the zenith and nadir, crosses the equinoctial at right angles, and divides the sphere into two hemispheres, the eastern and western: it has its poles in the east and west points of the horizon. It is called meridian, because when the sun cometh to the south part of this circle, it is then mid-day; and then the sun has his greatest altitude for that day. These meridians are various, and change according to the longitudes of places; so that they may be said to be infinite in number, for all places from east to west have their several meridians: but there is (or should be) one fixed, which is called the first meridian. Ptolemy chose to make that the first meridian which passes near the Fortunate Islands, at about the distance of one degree from them; and reckons from thence to the east through Africa and Asia; choosing to begin at a place inhabited, and which was then the bounds and limits of the known part of the earth to the west, and to end at the eastern shore of Seain in Asia; but America being discovered not many ages ago, and long after Ptolemy's time, the first meridian was removed more to the west. Some made that the first meridian which passes through the isle of St. Nicholas, which is one of those near Cape Verd; and Hondius chose the isle of St. James to be the first in his map.

Others chose that which passes through the isle del Corvo, one of the Azores, because the needle was found not to decline from the north there and in the adjacent seas, but to lie in the meridian line; and this beginning Mercator chooses. But seeing there are other places where the needle points to the north, and it doth not so in every part of that meridian, geographers thought this not a sufficient reason; some fixing it at the shore of Brasil, that runs out into the sea. Later geographers choose to begin at the mountain Teneriffe, in the Fortunate or Canary islands, which is counted one of the highest on the earth; and the rather, because they thought some remarkable place should be chosen that might be most known to future ages; and so Ptolemy's first meridian, though long observed, was not laid aside without good reason. The French, since the year 1634, have taken that which goes through the west part of the isle of Faro, one of the Canaries. Astronomers also have taken divers places for the first meridian; the followers of Tycho fix it at Uraniburg, an island in the Danish streights, and calculate the celestial motions to that place, and from thence accommodate them to the rest. Others choose other places, according to the authors of the ephemeris they use, who calculate the ephemeris, and the planets places for the meridian of their own place; as Riccioli, who fixed his first meridian at Bologna; Mr. Flamsteed, at the Royal Observatory at Greenwich; and the French, at the Observatory at Paris. See Observatory. But without regard to any of these rules, our geographers and map-makers frequently assume the meridian of the place, or the capital of the country, for the first meridian; and thence reckon the longitudes of their places.

In the Philosophical Transactions, there is a suggestion that the meridians vary in time. This seems very probable from the old meridian line in the church of St. Petronio at Bologna, which is found to vary no less than eight degrees from the true meridian of that place at this time; and from that of Tycho Brahe at Uraniberg, which M. Picart observes varies eighteen minutes from the modern meridian. If there be any thing of truth in this line, Dr. Wallis says, the change must arise from a

change of the terrestrial poles (here on earth, of the earth's diurnal motion) not of their pointing to this or that of the fixed stars; for if the poles of the diurnal motion remain fixed to the same place on the earth, the meridians which pass through these poles must be the same. But this notion of the changes of the meridian, seems overthrown by an observation of M. Chazelles, of the French academy of sciences, who, when in Egypt, found that the four sides of a pyramid, built 3000 years ago, still looked very exactly to the four cardinal points; a position, which could never be looked on as fortuitous.

The meridian on the globe or sphere, is represented by the brazen circle, in which the globe hangs and turns. It is divided into four times 90, or 360°, beginning at the equinoctial. See GLOBE. On it, each way from the equinoctial, on the celestial globes, is counted the south and north declination of the sun or stars; and on the terrestrial globe, the latitude of places north or south. There are two points of this circle, which are called the poles of the world; and a diameter continued from thence through the centre of either globe, is called the axis of the earth or heavens, on which they are supposed to turn round. On the terrestrial globes there are usually thirty-six meridians drawn, one through every tenth degree of the equator, or through every tenth degree of longitude. The uses of this circle are, 1. To set the globes to any particular latitude. 2. To shew the sun's or a star's declination, right ascension, or greatest altitude, &c.

"To find the sun's meridian altitude or depression at night, by the globes." Bring the sun's place to the meridian above the horizon for his altitude at noon; which will shew the degrees of it, counted from the horizon. For his midnight depression below the north-point of the horizon, you must bring the opposite point to the sun's present place, as before to the meridian; and the degrees there intercepted between that point and the horizon, are his midnight depression.

Meridian line is an arch, or part of the meridian of a place, terminated each way by the horizon. Or it is the intersection of the plane of the meridian of the place with the plane of the horizon, vulgarly called a north and south line, because its direction is from one pole towards the other. It is of great use in astronomy, geography, dialling, &c. and on its exactness all depends; whence divers astronomers have taken infinite pains to have it to the last precision.

MERIDIAN *line*, on a dial, is a right line arising from the intersection of the meridian of the place, with the plane of the dial: this is the line of twelve o'clock, and from hence the division of the hour-lines begin. See DIAL.

MERIDIAN, *magnetical*, is a great circle passing through the magnetical poles, to which the magnetic needle, or needle of the mariner's compass, conforms itself.

MERIDIAN *altitude of the sun and stars*, is their altitude when in the meridian of the place where they are observed. Or it may be defined, an arch of a great circle perpendicular to the horizon, and comprehended between the horizon and the sun or star then in the meridian of the place.

"To take the meridian altitude with a quadrant." If the position of the meridian be known, and the plane of an astronomical quadrant be placed in the meridian line, by means of the plumb-line suspended at the centre, the meridian altitudes of the stars, which are the principal observations whereon the whole art of astronomy is founded, may easily be determined. The meridian altitude of a star may likewise be had by means of a pendulum-clock, if the exact time of the star's passage over the meridian be known. Now it must be observed, that stars have the same altitude for a minute before and after their passage by their meridian, if they be not in or near the zenith; but if they be, their altitudes must be taken every minute when they are near the meridian, and their greatest altitudes will be the meridian altitudes sought.

MERIDIONAL DISTANCE, in navigation, is the same with the departure, easting or westing, or the difference of longitude between the meridian under which the ship now is, and any other meridian she was before under.

MERIDIONAL PARTS, MILES, OR MINUTES, in navigation, are the parts by which the meridians in Mr. Wright's chart (commonly though falsely called Mercator's) do increase as the parallels of latitude decrease: and as the cosine of the latitude of any place, is equal to the radius or semidiameter of that parallel; therefore, in the true sea-chart, or nautical planisphere, this radius being the radius of the equinoctial, or whole sine of 90°, the meridional parts at each degree of latitude must increase, as the secants of the arch, contained between that latitude and the equinoctial, decrease. The tables, therefore, of meridio-

nal parts, which we have in books of navigation, are made by a continual addition of secants; they are calculated in some books for every degree and minute of latitude; and they will serve either to make or graduate a Mercator's chart, or to work the Mercator's sailing. To use them, you must enter the table with the degree of latitude at the head, and the minute on the first column towards the left hand, and in the angle of meeting you will have the meridional parts. Having the latitudes of two places, to find the meridional miles or minutes between them, consider whether one of the places lies on the equator, or both on the same side of it, or, lastly, on different sides. 1. If one of the proposed places lies on the equator, then the meridional difference of latitude is the same with the latitude of the other place, taken from the table of meridional parts. 2. If the two proposed places be on the same side of the equator, then the meridional difference of latitude is found by subtracting the meridional parts answering to the least latitude, from those answering to the greatest, and the difference is that required. 3. If the places lie on different sides of the equator, then the meridional difference of latitude is found by adding together the meridional parts answering to each latitude, and the sum is that required.

MERLON, in fortification, is that part of a parapet which is terminated by two embrasures of a battery. Its height and thickness is the same with that of the parapet; but its breadth is generally nine feet on the inside, and six on the outside. It serves to cover those on the battery from the enemy; and is better when made of earth well beat and close, than when built with stone; because these fly about and wound those they should defend.

MEROPS, in natural history, the *bee-eater*, a genus of birds of the order Picæ. Generic character: bill quadrangular, somewhat curved, compressed, and pointed; nostrils small, at the base of the bill; tongue slender, and in some species ciliated; the outer toe somewhat connected with the middle one. Gmelin notices twenty-six species, and Latham twenty. We shall mention only M. apiaster, or the common bee-eater: this is about ten inches long, and found in many countries of Europe, though never observed in Great Britain. It is particularly fond of bees, but will eat various other insects; many of which it seizes; and like the swallow, on the wing. When insects are with difficulty to be found, it feeds on many species of seeds. In the markets of Italy it is frequently to be seen among the poulterers collections. It builds in the deep holes to be found on the banks of rivers. In the island of Candia these birds are often taken by boys, in the same manner as swallows, by a line, with an insect attached to a hook at the end of it. The cockchafer is chiefly employed for this purpose, notwithstanding its being thus fastened, it continues its flight, and is thus the most effectual of the decoys used on those occasions.

MESEMBRYANTHEMUM, in botany, *fig-marigold*, a genus of the Icosandria Pentagynia class and order. Natural order of Succulentæ Ficoideæ, Jussieu. Essential character: calyx five cleft; petals numerous, linear; capsule fleshy, inferior, many seeded. There are seventy-five species, of which M. nodiflorum Egyptian fig-marigold is a native of Egypt, where they cut up the plants, and burn them for pot-ash: it is esteemed the best sort for making hard soap and the finer glass: it is an annual plant, with diffused, decumbent stems; calyxes five-toothed, two of the teeth larger, leaf shaped; petals flat, narrow, connate at the base; stigmas usually five. M. crystallinum, diamond fig marigold, or ice plant: this is also an annual, distinguished by its leaves and stalks, being closely covered with pellucid pimples full of moisture, which, when the sun shines on them, reflect the light, appearing like small bubbles of ice, whence its name; many call it the diamond ficoides.

MESENTERY, a thick fat membrane, placed in the midst of the intestines, particularly of the smaller ones, whence it has the name.

MESPILUS, in botany, a genus of the Icosandria Pentagynia class and order. Natural order of Pomaceæ. Rosaceæ, Jussieu. Essential character: calyx five cleft; petals five; berry inferior, five seeded. There are nine species, of which M. germanica, Dutch medlar; this tree never rises with an upright trunk, but sends out crooked deformed branches, not far from the ground; the leaves are large, entire, and downy on their under side; flowers very large, as is also the fruit, which is rounder and approaches nearer to the shape of an apple. This tree bearing the largest fruit is now generally cultivated: the Nottingham medlar has a more poignant taste, but the fruit is considerably less.

MESSERSCHIMIDIA, in botany, so, named from Daniel Gottlieb Messerschmid a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: corolla funnel form, with a naked throat; berry suberous, bipartile, each two seeded. There are two species, viz. M. fructicosa, and M. arguzia.

MESUA, in botany, so called from John Mesue, a physician, a genus of the Monadelphia Polyandria class and order. Natural order of Guttiferæ, Jussieu. Essential character: calyx simple, four leaved; corolla four petalled; pistil one; nut four cornered, one seeded. There is but one species, viz. M. ferrea, a native of the East Indies: it is much cultivated in Malabar, for the beauty of the flowers; it bears fruit from the nut at six years old, and continues frequently bearing during three centuries. It is a very large tree, spreading like the lime; the flowers resemble our sweetbriar roses, having only four white petals; the fruit when ripe has a rind like that of the chesnut, with three or four kernels within of the substance, shape, and taste of chesnuts.

METACARPUS, in anatomy, that part of the hand between the wrist and the fingers.

METALS, according to strict definition, are inflammable bodies, being all capable of combining with oxygen, and many of them, during this combination, exhibit the phenomena of combustion. Formerly only seven metals were known, but modern discoveries have added to the number about twenty others, which are distinguished by their great specific gravity, considerable tenacity and hardness, opacity, and property of reflecting the greater part of the light which falls on their surface, giving rise to what is denominated the metallic lustre or brilliancy. See Lustre. To these have been added two others by Mr. Davy, who has discovered the method of decomposing potash and soda, and producing therefrom the new metals called by that professor Potassium and Sodaium. See Potassium and and Sodaium, under which terms a more particular account of these metals will be given. Of the others the principal characteristic is their superior specific gravity. In this they exceed all other bodies, the lightest being about six times heavier than water, the common standard, while the specific gravity of the heaviest substance with which we are acquainted, that is not metal, is less than five times heavier than water. Opacity is another leading property of metals; even when beat to the greatest possible thinness, they transmit scarcely any light: from the union of the two qualities, density and opacity, arises that of lustre. By their opacity and the denseness of their texture, they reflect the greater part of the light that falls on their surface. From their density they are susceptible of a fine polish, by which their lustre is increased. Colour is not a characteristic property of metals, but it serves to distinguish them from each other. Their colours are generally shades of white, grey, or yellow. Tenacity distinguishes a number of the metals, and is not possessed in any great degree by other bodies: hence arises their Malleability and Ductility, which see. Some of the metals are neither malleable nor ductile. Metals are less hard than the diamond and many fossils, and their elasticity follows the same order as their hardness. Both these qualities are greater in combinations of the metals than in the individual metals, and both may be increased by raising the metal to a high temperature, and then suddenly cooling it. Metals are the best conductors of caloric; their expansibilities are various, and are probably nearly in the order of their fusibilities. Mercury melts at so low a temperature, that it can be obtained in the solid state only at a very low temperature; others, as platina, can scarcely be melted by the most intense heat, which we can excite. In congealing, some of the metals expand considerably, especially iron, bismuth, and antimony; the others contract, some of them to a great extent, the contraction of mercury being equal to the $\frac{1}{23}$rd of the whole volume. Metals may be volatilized; at the degree of 600 quicksilver may be volatilized; and zinc and arsenic at a temperature not very remote from this; many others may be dissipated in the focus of a large burning mirror, or by a powerful galvanic battery. Metals are the best conductors of electricity.

Metals are susceptible of combination; they have an affinity to oxygen, hydrogen, carbon, sulphur, phosphorus, and to each other, and when combined with oxygen, to all the acids, to the alkalies, and to the earths. The metals, independently of potassium and sodaium, may be thus enumerated and arranged.

Metals
- oxydable by heat
  - acidifiable
    - volatile
      - Arsenic
    - fixed
      - Molybdena
      - Tungstin
      - Chrome
      - Columbium
  - not acidifiable
    - brittle
      - infusible or granular
        - Osmium
        - Uranium
      - fusible
        - Tantalium
        - Titanium
        - Tellurium
        - Manganese
        - Cobalt
        - Antimony
        - Bismuth
    - malleable
      - Zinc
      - Lead
      - Tin
      - Iron
      - Copper
      - Mercury
- not oxydable by heat
  - granular and brittle
    - Iridium
    - Rhodium
  - fusible and malleable
    - Palladium
    - Nickel
    - Platina
    - Silver
    - Gold

Metal, in heraldry. There are two metals used in heraldry, by way of colours, *viz.* gold and silver, in blazon called *or* and *argent*. In the common painting of arms these metals are represented by white and yellow, which are the natural colours of those metals. In engraving, gold is expressed by dotting the coat, &c. all over; and silver, by leaving it quite blank.

It is a general rule in heraldry, never to place metal upon metal, nor colour upon colour; so that if the field be of one of the metals, the bearing must be of some colour; and if the field be of any colour, the bearing must be of one of the metals.

METALLURGY, comprehends the whole art of working metals from the state of ore to the utensil; hence assaying, gilding, refining, smelting, &c. are only branches of metallurgy. In a more limited sense, it includes only the operations which are followed in separating metals from their ores. See Assaying, &c.

METAPHOR, in rhetoric, a trope, by which we put a strange word for a proper word, by reason of its resemblance to it; or it may be defined, a simile or comparison intended to enforce and illustrate the thing we speak of, without the signs or forms of comparison.

METAPHYSICS. See Philosophy, *mental.*

METEOR, in physiology, a moveable igneous body, congregated in the air by means not thoroughly understood, and varying greatly in size and rapidity of motion. Many attempts have been and are still made to account for the formation and ignition of these grand objects. Dr. Woodward, of the old school, seems to have approached nearer to modern opinions, founded on recent observations, than any other writer on the subject. That gentleman supposed them to originate from mineral particles raised from the earth by subterraneous heat, accompanied by vapours from the same strata, which furnished the minerals, and being condensed by the pressure of the atmosphere, partake of the immediate action of the bodies they intersect in their passage. Derham thought the ignis fatuus a vapour on fire; Beccaria, on the contrary, supposed them to be vapour forced out of the earth by the descent of rain or snow, and not decidedly burning, but rather of the nature of cold phosphori. Franklin conjectures, in the Memoirs of the Manchester Society, that the dense fog of 1783 may have been produced by smoke arising from the combustion of some of those vast globes, "which we happen to meet with in our rapid course round the sun." The generality of the meteors observed resemble each other, except in size,

which cannot be ascertained with certainty, on account of the apparent diminution of bodies through distance. The most remarkable of late times were those of 1783 and 1805: the former was very luminous, and its supposed diameter 1000 yards: the latter passed with such astonishing rapidity, that amazement had not subsided ere it vanished, consequently very little dependence can be placed on what has been said concerning its bulk and shape; the light which it emitted was a pale blue, and almost as instantaneous as a flash of lightning, and the rushing of the enormous body produced a sound like very distant thunder. Some of the smaller meteors explode after a certain interval of burning, and it has been uniformly asserted that they deposited stones; the apparent improbability of this assertion long prevented persons of enlightened minds from crediting it, and till Dr. Chladni published a dissertation on the subject in 1794, which induced Mr. King to collect every instance, ancient and modern, calculated to establish the fact with the public, and this was no easy task. Mr. Howard followed the example of those two gentlemen; but went further, and actually procured specimens of the substances alluded to, which having compared, he proceeded to analyse by chemical means. He found them entirely different from all known stones, and exactly resembling each other, even in their component parts.

It has been said that the stones, thus incontestibly proved by different authorities, and from various places, to have fallen after the explosion of meteors, are heated and luminous when they reach the earth: the force of their descent buries them some depth into it, and they have been seen under these circumstances in Italy, Germany, France, England, and India. The meteors either really do, or appear to, move horizontally, and are said to descend ere they explode. The stones are of different sizes, and from a few ounces in weight to several tons: they are generally circular, and invariably covered with a rough black crust, which, according to Howard, is principally composed of oxide of iron. The process adopted by that gentleman produced a result which has since been confirmed by Klaproth and Vauquelin. We shall give the analysis of two of these substances, by Howard, of a stone which fell in Yorkshire; and by Vauquelin and Fourcroy, of another that fell at Laigle in France, 1803.

Mr. Howard found that 150 grains contained

75	Silica
37	Magnesia
48	Oxide of iron
2	Oxide of nickel.
162	

The oxidizement of the metallic bodies caused this increase of weight. Messrs. Vauquelin and Fourcroy found the mass they examined contained

54	Silica
36	Oxide of iron
9	Magnesia
3	Oxide of nickel
2	Sulphur
1	Lime
105	

The conjectures which these extraordinary productions have occasioned are visionary in the extreme: indeed M. Laplace supposes them to be fragments ejected by volcanos in the moon: Sir William Hamilton and Mr. King, on the contrary, imagine that they are concretions formed in the atmosphere.

METEOROLOGY, is the science of studying the phenomena of the atmosphere, and the term by which is expressed all the observations that tend to make them a system. There are many most important meteorological phenomena, and those may be classed under five distinct heads; for instance, the alterations that occur in the weight of the atmosphere, those that take place in its temperature, the changes produced in its quantity by evaporation and rain, the excessive agitation to which it is frequently subject, and the phenomena arising from electric and other causes, that at particular times occasion or attend the precipitations and agitations alluded to.

All the above phenomena prove to demonstration that constant changes take place, the consequences of new combinations and decompositions rapidly following each other. The majority of meteorological alterations depend on these chemical changes, and were we accurately acquainted with the peculiarities of all the substances which form the component parts of the atmosphere, nothing would be more easy than to explain the result of their mutual action; but as that is unfortunately not the case, we must be contented to build

upon strong probabilities supported in many instances by positive experiment.

It is singular that this science should have remained for so long a period in a state of comparative neglect, when it is recollected that almost all the operations necessary for the support of human life, and almost all the comforts of corporeal feeling, depend upon the state of the atmosphere, and yet nothing was attempted to any purpose towards investigating the laws of meteorology till the seventeenth century, when the most important discoveries of the barometer and thermometer occurred, which was followed in the eighteenth by the invention of excellent hygrometers and electrometers; by these the philosopher finds himself competent to make accurate and satisfactory observations. Scientific persons, who have particularly turned their attention to this pursuit, have undertaken the laborious task of collecting and methodically arranging numbers of the observations just mentioned, and after attentively comparing and examining them have formed theories of the weather of more or less probable accuracy; but the science is of such difficulty that though those theories deserve every praise, we are compelled to acknowledge the phenomena of the weather is still very imperfectly understood. This acknowledgment, however, reflects no discredit on those ingenious men, as it is impossible that any thing like certainty should be attained, till observations that can be depended upon are procured from all parts of the globe, the atmosphere has been more accurately explored, and the chemical changes occurring in it are correctly ascertained.

To render our explanation of this subject as satisfactory as circumstances will permit we shall proceed in the succession before pointed out; with respect to the changes in the weight of the atmosphere, it is generally known that the instrument called the barometer shews the weight of a body of air immediately above it extending to the extreme boundary of the atmosphere, and the base of which is equal to that of the mercury contained within it. As the level of the sea is the lowest point of observation, the column of air over a barometer placed at that level is the longest to be obtained; in this case the mean height of the barometer is thirty inches. According to the experiments of Sir George Shuckburgh in the Channel and the Mediterranean Sea in the temperature of 55° and 60°, this was found to be the case, and the result is confirmed by those of M. Bouguer on the coast of Peru in the temperature of 84°, and Lord Mulgrave in latitude 80°. From these data, it is evident that the mean height of the barometer decreases in proportion with its elevation above the level of the sea, and in proportion to the consequent shortening of the columns of air; hence it is used for measuring heights. The keeping of a barometer in one particular place does not make the mercury stationary, as it will vary by rising or falling to the extent of several inches, of necessity the weight of the air which balances the mercury must be subject to the same changes; this circumstance proves that the gravity of the air in any given situation varies greatly, being at one time light and another heavy, an effect which must be caused by changes in its quantity, and a fact that demonstrates the air of every place liable to perpetual alterations, which must arise from the accumulation of air in particular places, and a reduction in others, "or," as Dr. Thomson observes, "part of the atmosphere must be alternately abstracted altogether, and restored again by some constant, though apparently irregular process."

The variations of the barometer between the tropics are very trifling, and it is worthy of observation, it does not descend more than half as much in that part of the globe for every two-hundred feet of elevation as it does beyond the tropics, which we learn from the Journal de Physique; besides, the barometer rises about two-thirds of a line twice during each day in the torrid zone. We are informed by M. Horsburgh that from latitude 26° north to latitude 27° south, which includes the space termed the tropical seas, the mercury attained its greatest elevation at eight in the morning, from which hour till noon it continued stationary, it then began to fall and descended till about four o'clock, when it reached the lowest point of depression. In the interval between four and five the mercury rose, and continued to rise till about nine or ten P. M. when it had once more arrived at its most elevated point, where it remained stationary till near midnight, when it fell and continued to fall, till at four A. M. it had descended as low as it had been at four in the afternoon, from that period till seven or eight it continued rising, and at the latter hour it had attained the highest point of elevation. The gentle-

man who made these observations termed the elevations and depressions now described equatropical motions, and asserts, that they were regularly performed while the barometers were on the sea, but they were seldom observed on a river, or when the instruments were on shore. This circumstance leads us to concur with Dr. Thomson, in supposing that the singular fact is to be ascribed to the motion of the ship, "which by regularly agitating the mercury, might make its elevations and depressions more sensible and correct than when the barometer continues stationary." The range of the barometer increases gradually as the latitude advances towards the poles, till in the end it amounts to two or three inches. The following table, composed by the writer just cited, will explain the gradual increase alluded to, which he compiled from the best authorities.

Latitude		Places	Range of the barometer			
			Greatest		Annual.	
0°	0′	Peru	0	20	–	—
22	23	Calcutta	0	77	–	—
33	55	Cape Town	–	—	0	89
40	55	Naples	1	00	–	—
51	8	Dover	2	47	1	80
53	13	Middlewick	3	00	1	94
53	23	Liverpool	2	89	1	96
59	56	Petersburgh	3	45	2	77

The range of the barometer is considerably less in North America than in the corresponding latitudes of Europe, particularly in Virginia, where it never exceeds 1.1. The range is more considerable at the level of the sea than on mountains, and in the same degree of latitude it is in the inverse ratio of the height of the place above the level of the sea.

M. Cotte composed a table which has been published in the Journal de Physique, from which it appears extremely probable that the barometer has an invariable tendency to rise between the morning and the evening, and that this impulse is most considerable from two in the afternoon till nine at night, when the greatest elevation is accomplished; but the elevation at nine differs from that at two by four-twelfths, while that of two varies from the elevation of the morning only by one-twelfth, and that in particular climates the greatest elevation is at two o'clock. The observations of M. Cotte confirm those of Mr. Luke Howard, and from them it is concluded that the barometer is influenced by some depressing cause at new and full moon, and that some other makes it rise at the quarters. This coincidence is most considerable in fair and calm weather; the depression in the interval between the quarters and conjunctions amounts to one-tenth of an inch, and the rise from the conjunctions to the quarters is to the same amount.

The range of this instrument is found to be greater in winter than in summer; for instance, the mean at York during the months from October to March inclusive, in the year 1774 was 1.42, and in the six summer months 1.016.

The more serene and settled the weather is the higher the barometer ranges, calm weather with a tendency to rain depresses it, high winds have a similar effect on it, and the greatest elevation occurs with easterly and northerly winds, but the south produces a directly contrary effect. According to the Asiatic Researches it is always observed to be highest with north and north-west winds, and the reverse when the south-east prevails; it falls rapidly previous to violent tempests, and is greatly agitated while they continue. It has been remarked by Mr. Copland in the Transactions of the Society of Manchester, that "a high barometer is attended with a temperature above, and a low barometer with one below, the monthly mean." Various but almost altogether unsuccessful attempts have been made to explain the phenomena we have enumerated; that of Mr. Kirwan carries considerable plausibility, though it is not considered quite satisfactory. In order that his ideas on the subject may be clearly understood, we shall give what may be considered an abstract of his theory, improved by Dr. Thomson. The density of the atmosphere is evidently greatest at the poles, and least at the equator, as the centrifugal force at the latter, the distance from the centre of the earth, and the heat, all contributing to lessen the density of the air, are at their maximum, when at the pole it is exactly the reverse. In every part of the world the mean height of the barometer placed at the level of the sea will be found to be 30 inches, consequently, the weight of the atmosphere is the same in all places; its weight depending on its density and height; where the former is greatest the height must be the least, and where its density is least the height is the greatest. Arguing from these facts it will, therefore, appear that the height of the atmosphere

must be least at the poles, and greatest at the equator, decreasing gradually in the interval, and thus forming the resemblance of two inclined planes, meeting at the highest part above the equator.

The difference of the mean heat between the pole and the equator, when the sun is in our hemisphere in the summer, does not vary so much as in the winter, as the heat at that period in northern countries equals that of the torrid zone; hence the thermometer rises to 85° in Russia during the months of July and August, of necessity the rarity of the atmosphere and its height increases; in consequence, the upper part in the northern hemisphere inclines less, but that of the southern, from different causes, must be much more inclined; during our winter the exact reverse takes place.

The pressure of the superincumbent column in a great measure causes the density of the atmosphere, and therefore decreases in proportion to the height as the pressure of the column constantly decreases, yet the density in the torrid zone does not decrease so rapidly as in the temperate and frigid, as the column is longer, and because there is a larger proportion of air in the upper part of it. This fact agrees with the assertion of M. Cassan, "that the barometer only sinks half as much for every two hundred feet of elevation in the torrid, as in the temperate zones." The density at the equator, though less at the surface of the earth, must equal at a certain height, and still higher exceed the density in the temperate zones, and at the poles.

It is ascertained that a current of air constantly ascends at the equator, part at least of which reaches to and remains in the highest parts of the atmosphere; the fluidity of that body prevents it from accumulating above the equator, and hence it must descend the declined plane before mentioned. The surface of the atmosphere being more inclined in the northern hemisphere during our winter than that of the southern, more of the current must flow on the northern than on the southern, from which cause the quantity of our atmosphere is greater in winter than that of the southern hemisphere; in the summer it is just the contrary; consequently the range of the barometer is less in summer than in winter, and the greatest mercurial heights occur during winter.

The heat of any given place in a great measure influences the density of its atmosphere, that density will be most considerable where it is coldest, and its column shortest. Chains of mountains, the summits of which are covered with snow great part of the year, and highlands, must be colder than places less elevated in the same latitude, and the column of air over them much shorter. The current of air above must be impeded and accumulate while on its passage over these places towards the poles, which causing an agitation, it will be communicated to, and indicated by, the barometer in a singular manner. These accumulations occur over the north-west parts of Asia and North America, and this raises the barometer, and causes less variation in it there than in Europe. It is precisely so on the Pyrenees, the Alps, and the mountains in Africa, Turkey in Europe, Tartary, and Tibet. After the accumulations have existed some time the surrounding atmosphere becomes incapable of balancing the density of the air, when it descends with violence, and occasions cold winds, which raise the barometer; it is to this that we are to attribute the rise of the barometer, almost always attending north-east winds in Europe, which is the effect of accumulations near the pole, or in the north-west parts of Asia; it is thus besides that the north-west wind from the mountains of Tibet raises the barometer at Calcutta. It may be supposed that in the polar regions large quantities of air are casually compressed; when this is the case the southern atmosphere must rush in to replace it, which occasions south-west gales and the fall of the barometer.

The mean heat of our hemisphere varying in successive years, the density of the atmosphere, and necessarily, the quantity of equatorical air passing towards the poles, cannot be otherwise than variable, hence occurs the different ranges of the barometer in successive years; at some particular periods, more considerable accumulations take place in the highest parts of Asia, and the south of Europe, than at others, which may be produced by early falls of snow, or the interruption of the sun's rays by long continued fogs; at such times the atmosphere in the polar regions becomes proportionably lighter, and this causes the prevalence of southerly winds in some winters more than in others. The heat of the torrid zone never greatly varying, the height and density of the atmosphere undergoes but few changes, thence arises the comparatively small range of the barometer within the tropics, which gradually in-

creases towards the poles as the difference of the temperature, and the density of the atmosphere increases with the latitude. The sinking of the barometer preceding violent tempests, and the oscillations during their continuance, prove that very great rarefactions, or even destruction of air, in some part of the atmosphere produce those phenomena; the fall too that accompanies winds arise from the same cause. Unfortunately we are but little acquainted with the operations which produce rain, consequently we are unable to explain satisfactorily why the barometer falls immediately preceding it.

The most inattentive observer of the phenomena of nature must have noticed that there are considerable variations in the temperature of the air in any particular place, exclusive of the differences of seasons and climates, which eternal changes cannot be produced by heat derived from the sun, as its rays concentrated have no kind of effect on air, those however heat the surface of our globe, which is communicated to the immediate atmosphere; it is through this fact that the temperature is highest where the place is so situated as to receive with most effect the rays of the sun, and that it varies in each region with the season; it is also the cause why it decreases in proportion to the height of the air above the surface of the earth. The most perpendicular rays falling on the globe at the equator, there the heat of it is the greatest, and that heat decreases gradually to the poles, of course the temperature of the air is in exact unison; from this, it appears, that the air acquires the greatest degree of warmth over the equator, whence it becomes insensibly cooler till we arrive at the poles; in the same manner, the air immediately above the equator cools gradually. Though the temperature sinks as it approaches the pole, and is highest at the equator, yet as it varies continually with the seasons, it is impossible to form an accurate idea of the progression without forming a mean temperature for a year, from that of the temperature of every degree of latitude for every day of the year, which may be accomplished by adding together the whole of the observations, and dividing by their number, when the quotient will be the mean temperature for the year. "The diminution," says Dr. Thomson, "from the pole to the equator takes place in arithmetical progression; or to speak more properly the annual temperature of all the latitudes, are arithmetical means between the mean annual temperature of the equator and the pole." Mr. Mayer has the honour of this discovery, but Mr. Kirwan rendered it more simple and plain, by founding an equation on it, by which he calculated the annual mean temperature of every degree of latitude between the equator and the pole; the following was the principle of proceeding. "Let the mean annual heat at the equator be m, and at the pole $m - n$; put Φ for any other latitude; the mean annual temperature of that latitude will be $m - n \times \sin. \Phi^2$. If therefore the temperature of any two latitudes be known, the value of m and n may be found. Now the temperature of north lat. 40° has been found by the best observations to be 62.1°, and that of lat. 50°, 52.9°. The square of the sine of 40° is nearly 0.419, and the square of the sine of 50° is nearly 0.586. Therefore,

$$m - 0.41\, n = 62.1, \text{ and}$$
$$m - 0.58\, n = 52.9, \text{ therefore}$$
$$62.1 + 0.41\, n = 52.9 + 0.58\, n$$

as each of them, from the two equations is equal to m. From this last equation the value of n is found to be 53 nearly; and m is nearly equal to 84. The mean temperature of the equator, therefore is 84°, and that of the pole 31°. To find the mean temperature for every other latitude, we have only to find 88 arithmetical means between 84 and 31."

Mr. Kirwan calculated a table of the mean annual temperature of the standard situation in every latitude, which answers only for those of the atmosphere of the ocean, as it was made for that part of the Atlantic situated between 80° north and 45° south latitude, extending westward to the gulf stream, within a few leagues of the American coast; and for all that part of the Pacific Ocean from the 45th degree of northern to the 40th of southern latitude, from the 20th to the 275th degree of longitude east of London. Mr. Kirwan terms this part of the ocean the standard, as the rest is subject to anomalies to be mentioned hereafter. The same industrious gentleman ascertained the monthly mean temperature of the standard ocean; that of April approaches very nearly to the annual mean, "and as far as heat depends on the action of solar rays, that of each month is as the mean altitude of the sun, or rather as the sine of the sun's altitude. The learned investigators to whom we are indebted for these experiments and observations, say,

" As the sine of the sun's mean altitude in April is to the mean heat of April, so is the sine of the sun's mean altitude in May to the mean heat of May. In the same manner the mean heats of June, July, and August, are found; but the rule would give the temperature of the succeeding months too low, because it does not take in the heat derived from the earth, which possesses a degree of heat, nearly equal to the mean annual temperature. The real temperature of these months, therefore, must be looked upon as an arithmetical mean between the astronomical and terrestrial heats. Thus in latitude 51°, the astronomical heat of the month of September is 44.6°, and the mean annual heat is 52.4°; therefore the real heat of this month should be $\frac{44.6+52.4}{2} = 48.5$.

After many laborious calculations Mr. Kirwan had the mortification to find their results differed so much from observations, that he was induced to make a table from various sea journals, and certain principles for the monthly mean temperature of the standard, from lat. 80° to lat. 10°, from which he decides that the coldest month in every latitude is January, and that July is the warmest in all above 48°, in lower August. In proportion to the distances from the equator is the increase and decrease of heat, but every latitude where existence can be maintained has a mean of 60°, two months of the year at the least, which is requisite for the production of those articles by which man supports life. The temperatures within ten degrees of the poles vary little, and the case is similar within the same distance from the equator; those of different years near the latter differ very little, but the differences increase as the latitudes approach the poles. It is well known that the temperature of the atmosphere diminishes gradually in proportion to its height above the level of the sea. The late Dr. Hutton of Edinburgh made some experiments on this head by placing a thermometer on the summit of Arthur's Seat, a hill so named, and another at the base of it, by which he found that the former generally stood at three degrees lower than the latter, in this instance therefore a height estimated at 800 feet produced a diminution of heat amounting to three degrees. Bouguer made a similar experiment to ascertain the difference of temperature between the level of the sea and the top of Pinchinca, one of the Andes, when the thermometer at the summit stood at 30° and that below in the same latitude at 84°; the diminution was 54° in a supposed height of 15,564 feet. Thus far the operation is easy and practicable, but the grand difficulty lies in determing the exact gradations between the highest and lowest points of observation, conjectures on this subject have been hazarded by Euler and Saussure, the first gives it in harmonic progression, and Saussure supposed the decrease of temperature to amount to 1° for 287 feet of ascent. Mr. Kirwan, however, rejecting those improbabilities, shews in the Transactions of the Royal Irish Academy, that the rate of diminution depends upon the precise temperature of the surface of the earth where an experiment is made; he has besides invented an ingenious mode of ascertaining the rate in every instance, admitting the temperature at the surface to be known.

This gradual approach to cold, demonstrates that at a certain height eternal congelation must prevail; that height varies of course according to the latitude of the place, being highest at the equator, and gradually descending on approaching the poles; it is also lower in the winter. The cold on the summit of Pinchinca was found, by M. Bouguer, to extend from seven to nine degrees every morning previous to the rising of the sun below the freezing point, from which he conjectured, that the mean height of the term of congelation (or that region where water congeals on some part of every day in the year) between the tropics, is 15,577 feet above the level of the sea; in latitude 28°, he supposes it to be 13,440 during summer; taking " the difference between the freezing point and the equator, it plainly appears, that it bears the same proportion to the term of congelation at the equator that the difference between the mean temperature of any other degree of latitude, and the freezing point, bears to the term of congelation in that latitude." " Thus," continues Dr. Thomson, " the mean heat of the equator being 84°, the difference between it and 32 is 52; the mean heat of latitude 28° is 72.3°, the difference between which and 32 is 40.3. Then 52 : 15,577 : : 40.3 : 12072." Mr. Kirwan calculated another table on this subject, from latitude 0, where he makes the mean height of the term of congelation 15,577, by gradations of five degrees, up to latitude 80—120 feet; higher than this, call-

ed the lower term of congelation, which varies with circumstances and seasons, M. Bouguer places another, called by him the upper term, and beyond this no visible vapour ascends. The former gentleman supposes this line far less liable to variation in the summer than the lower term, and therefore adopted it to ascertain the rate of diminution of heat on ascending into the atmosphere. Bouguer determined the height of this term in one instance, but Kirwan went further, and produced a table of its height for every degree of latitude in the northern hemisphere. We shall quote Mr. Kirwan's rule for obtaining the temperature at any given height, admitting that the temperature at the surface of the earth is known. "Let the observed temperature at the surface of the earth be $= m$, the height given $= h$, and the height of the upper term of congelation for the given latitude be $= t$; then $\frac{m - 32}{\frac{t}{100} - 1} =$ the diminution of temperature for every 100 feet of elevation; or it is the common difference of the terms of the progression required. Let this common difference thus found be denoted by c, then $c \times \frac{h}{100}$ gives us the whole diminution of temperature from the surface of the earth to the given height. Let this diminution be denoted by d, then $m - d$ is obviously the temperature required. An example will make this rule sufficiently obvious. In latitude 56°, the heat below being 54°, required the temperature of the air at the height of 803 feet.

Here $m = 54$, $t = 5,533$, $\frac{m \quad 32}{\frac{t}{100} - 11} = \frac{22}{54.33}$ $= 0.404 = c$, and $c \times \frac{h}{100} = 0.404 \times 8.03 = 3.24 = d$, and $m - = 54 - 3.24 = 50.75$: here we see that the temperature of the air 803 feet above the surface of the earth is 50° 75″.

Estimating the diminution from this method, which corresponds with observation, we find that heat lessens in an arithmetical progression; and from the same premises it may be concluded, that the warmth of the air at some distance from the earth is not to be attributed to the rising of heated strata of air from the earth's surface, but to the conducting power of the air.

The upper strata of the atmosphere are frequently warmer in winter than the lower, and the preceding rule is applicable to the temperature of the air during the summer months only. According to the Philosophical Transactions for 1777, a thermometer placed on the summit of Arthur's Seat, the thirty-first of January, the year before, stood six degrees higher than a second at Hawkhill, situated 684 feet below it: this superior heat is considered by Mr. Kirwan to be produced by a current of heated air flowing from the equator towards the north pole during our winter. A general idea has now been given of the method by which the mean annual temperature may be found throughout the known regions of the globe; but there are some exceptions to the universality of the rules: for instance, the Pacific Ocean, between latitude 52° and 66° north, and at the northern extremity, is only 42 miles in breadth, and at its southern is 1300 miles; it is therefore but reasonable to suppose, that the temperature must be greatly affected by the land surrounding it, which rises into chains of mountains, with summits bearing snow great part of the year, exclusive of the islands consisting of high lands scattered within it. Mr. Kirwan concludes, in consequence, that its temperature is four or five degrees below the standard. This supposition cannot, however, be brought to any degree of certainty, from a deficiency of observations. It has been a generally received opinion, that the southern hemisphere, beyond the fortieth degree of latitude, is much colder than corresponding parts of the northern: this our philosopher has proved to be true with respect to the summer of the former; but that the winter in the same latitude is milder than in the latter.

Inconsiderable seas, in temperate and cold climates, are colder in winter and warmer in summer than the standard ocean, as they are necessarily under the influence of natural operations from the land, and its temperature, particularly the Gulph of Bothnia, which is generally frozen in the winter, but the water is sometimes heated in the summer to 70°, a state the opposite part of the Atlantic never acquires; the German Sea is five degrees warmer in summer than the Atlantic, and more than three colder in winter; the Mediterranean is almost throughout warmer both in winter and summer, which therefore causes the Atlantic to flow into it; and the Black Sea being colder than the Mediterranean, flows into the latter.

It appears from meteorological tables,

that the eastern parts of North America has a much colder air than the opposite European coast, and falls short of the standard by about ten or twelve degrees. There are several causes which produce this considerable difference. The greatest elevation in North America is between the 40th and 50th degree of north latitude, and the 100th and 110th of longitude west from London, and there the most considerable rivers have their origin. The height alone is sufficient to make this tract colder than it would otherwise be; but there are other causes, and those are most extensive forests, and large swamps and morasses, each of which exclude heat from the earth, and consequently prevent it from ameliorating the rigour of winter. Many extensive lakes lie to the east, and Hudson's Bay more to the north; a chain of mountains extend on the south of the latter, and those equally prevent the accumulation of heat; besides, this bay is bounded on the east by the mountainous country of Labrador, and has many islands; from all which circumstances arise the lowness of the temperature, and the piercing cold of the north-west winds. The annual decrease of the forests for the purpose of clearing the ground, and the consumption for building and fuel, is supposed to have occasioned a considerable decrease of cold in the winter; and if this should be the result, much will yet be done towards bringing the temperature of the European and American continents to something like a level.

Continents have a colder atmosphere than islands situated in the same degree of latitude; and countries lying to the windward of the superior classes of mountains, or forests, are warmer than those which are to the leeward. Earth always possessing a certain degree of moisture, has a greater capacity to receive and retain heat than sand or stones, the latter therefore are heated and cooled with more rapidity: it is from this circumstance that the intense heats of Africa and Arabia, and the cold of Terra del Fuego, are derived. The temperature of growing vegetables changes very gradually; but there is a considerable evaporation from them: if these exist in great numbers, and congregated, or in forests, their foliage preventing the rays of the sun from reaching the earth, it is perfectly natural that the immediate atmosphere must be greatly affected by the ascent of chilled vapours.

Our next object is the ascent and descent of water. The first-mentioned operation of this fluid has been noticed already. See Evaporation.

Dews, the effect of the same cause, are variously accounted for by different observers of nature; the general result, however, seems to be, that they are the last feeble efforts of evaporation, which deprived of their warm stimulus by the approach of night, fall through the chill of the air in extremely small and distinct globules, covering every substance with that trembling and brilliant lustre which rain is incapable of affording through the weight of each drop. According to Hales, 3.28 inches of dew annually falls on the earth; but Dalton asserts, that the quantity is about 5 inches in the same period. M. Prevost made some curious experiments to ascertain why dew should be deposited on glass, when it did not adhere to metal almost in contact: plates of metal fixed on glass are sometimes covered by dew, and at others the case is reversed; in the latter instance they are bounded by a dry zone: if the other surface of the glass is exposed, the part opposed to the metal remains perfectly dry, and if the metal is applied again it will not prevent the deposition. The experiment may be made at a window, when moisture attaches to either side. M. Prevost observes, that glass is covered externally, even when the air is warmest within the house, and that metal fixed internally receives more moisture than the glass. After pursuing the subject to its utmost limits, this gentleman concludes that the phenomena are entirely the effect of the action of heat. That description of dew known by the name of honey-dew is attributed to insects.

The strata of air near the surface of the earth unquestionably contains more moisture, or vapour, than the higher parts of the atmosphere. The regions above the summits of mountains are probably very dry; and De Luc and Saussure say, the air on those they explored was less impregnated with vapour in the night than during the day; for as the stratum next the earth condenses and cools at the former period, there can be no doubt that each stratum descends, yet as clouds are seen to tower far above the most elevated peaks, vapour must at particular times rise to an amazing height.

Rain never descends till the transparency of the air ceases, and the invisible vapours become vesicular, when clouds form, and at length the drops fall: clouds, instead of forming gradually at once throughout all

parts of the horizon, generate in a particular spot, and imperceptibly increase till the whole expanse is obscured. It is singular that clouds collect and spread at a considerable height in the atmosphere, where the air is drier than in the lower strata, which are generally overcharged with moisture. "It is equally remarkable," says a late writer, "that the part of the atmosphere at which they form has not arrived at the point of extreme moisture, nor near that point, even a moment before their formation." Thus it appears, that their formation does not proceed from a greater quantity of vapour accumulating than could remain in the atmosphere without passing its maximum. M. De Luc asserts, that the heat of clouds exceeds that of the surrounding air in some particular instances; hence their formation cannot arise from the capacity of air for combining with moisture being decreased by cold, as clouds may frequently be observed, which, after floating through the atmosphere during the heat of the day, disappear at night when the heat diminishes: thus we might proceed to prove that clouds do not originate in the way supposed by many observers, and that we are still ignorant in what manner vapour is disposed of after it enters the atmosphere; and why it rejects its assumed form, returns again to vapour, and falls in rain; and why evaporation should prevail during very hot and dry seasons, without visibly saturating the whole atmosphere. Theories in this instance are of very little use, as the subject is evidently placed too far out of our reach for experiment, in this state of uncertainty we must have recourse to facts.

The quantity of rain, taken at an annual mean, is the greatest at the equator, and it lessens gradually to the poles; but there are fewer days of rain there, the number of which increase in proportion to the distance from it. The Journal de Physique contains the following observations: "From north latitude 12° to 43°, the mean number of rainy days is 78; from 43° to 46°, the mean number is 103; from 46° to 50°, 134; and from 51° to 60°, 161." Winter often produces a greater number of rainy days than summer, though the quantity of rain is more considerable in the latter than in the former season: at Petersburgh rain and snow falls on an average 84 days of the winter, and the quantity amounts to about five inches; on the contrary the summer produces eleven inches in about the same number of days. Mountainous districts are subject to great falls of rain, among the Andes particularly it rains almost incessantly, while the flat country of Egypt is consumed by endless drought. The rain guage affords reason to suppose, that a greater quantity of rain falls in the lower strata of the atmosphere than in those above, which may be accounted for by the drops attracting vapour in their near approach to the earth, though it must be admitted, that Mr. Copland, of Dumfries, discovered the rain collected in the lower guage was greatest when it continued falling for some time, and that the greatest quantity was collected in the higher during short rains, or at the conclusion of lengthened ones.

As rain is known to fall at all hours of the day and night, and at every season of the year, it is apparent that it is caused by operations which prevail eternally, and without defined interruption. M. Toaldo seems to think that a greater quantity descends in the night than the day; and it is certain that a south wind produces more rain than any others, though it falls during the prevalence of every wind: heavy falls also occur in the most complete calms. M. Cotte published a paper in the Journal de Physique, from which it appears that the mean quantity of rain descending at 147 places, between latitude 11° and 60° north, is 34.7 inches. "Let us suppose then," observes Dr. Thomson, "(which cannot be very far from the truth) that the mean annual quantity of rain for the whole globe is 34 inches. The superfices of the globe consists of 170,981,012 square miles, or 686,401,498,471,475,200 square inches; the quantity of rain, therefore, falling annually will amount to 23,337,650,812,030,156,800 cubic inches, or somewhat more than 91,751 cubic miles of water."

There are 52,745,253 square miles of dry land on the globe; consequently the annual amount of the quantity of rain descending upon it will be 30,960 cubic miles. The sea is supposed to receive 13,140 cubic miles of water, which flows into it annually; therefore it must supply an equal quantity by evaporation, or the land would be completely drained of every particle of moisture. Mr. Dalton estimates the quantity of rain falling in England at 31 inches.

Exclusive of the general appearance of vapour when condensed into clouds, there are other forms in which the existence of moisture in the atmosphere is observable, particularly the halo, a luminous circle appearing under certain circumstances round the sun, moon, and stars. This has been almost universally ascribed to the rays of light issuing

[illegible]

[illegible] ator in the Indian [illegible] extend to the eastern coast [illegible] and [illegible] of New Holland [illegible] from Africa. they, however, suffer [illegible] local circumstances. They are, besides, not altogether confined [illegible] mentioned, as the wind [illegible] from the east or north-east between September and April, and for the remainder of the year from the south-west on the [illegible] Brazil, between Cape St. Agustine [illegible] St. Catherine. Having thus [illegible] the attention of the reader to this [illegible] we shall pass to the pre[illegible] country, which [illegible] of the Royal Society of London, which learned body [illegible] in their Trans[illegible]

[illegible]	[illegible]	[illegible]	Days.
[illegible]	[illegible]	South-east....	32
N[illegible]	[illegible]	East..........	26
N[illegible]	[illegible]	South..........	18
West	[illegible]	North..........	16

The same register shews, that the south-west [illegible] upon an average in [illegible] than any other, par[illegible] and August: that the north-[illegible] January, March, April, [illegible] most unfrequent in [illegible] September, and December; [illegible] more frequently [illegible] March, and less so in [illegible] than in any other [illegible] volume of the Statis[illegible] and there is a table of [illegible] made by Dr. [illegible] average of which [illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	N[illegible]-east..	[illegible]
N[illegible]	[illegible]	[illegible]	[illegible]

[illegible] winds are the [illegible] to [illegible] which was conveyed with great velocity by

the wind at the rate of 70 miles an hour, while a perfect calm existed in the city and neighbourhood.

There are many circumstances attending the operations of the air, which we term wind, that serve for a basis for well-founded conjectures, and those united to the result of daily observation, render the explanation of its phenomena tolerably satisfactory. It must be clear to the most common capacity, that as the rays of the sun descend perpendicularly on the surface of the earth under the torrid zone, that part of it must receive a greater portion of heat than those where they fall obliquely; the heat thus acquired communicates to the air, which it rarifies and causes to ascend, and the vacuum occasioned by this operation is immediately filled by the chill air from the north and south. The diurnal motion of the earth gradually lessens to the poles from the equator: at that point it moves at the rate of fifteen geographical miles in a minute: this motion is communicated to the atmosphere in the same degree; therefore if part of it was conveyed instantaneously from latitude 30° it would not directly acquire the velocity of that at the equator; consequently the ridges of the earth must meet it, and give it the appearance of an east wind; the effect is similar upon the cold air proceeding from the north and south, and this similarity must be admitted to extend to each place particularly heated by the beams of the sun.

The moon being a large body, situated comparatively near the earth, is known to affect the atmosphere in its revolutions by the pressure of that upon the sea, so as to cause the flux and reflux of it, which we term tides, it cannot, therefore, be doubted that some of the winds we experience are caused by her motion.

The regular motion of the atmosphere, known by the name of land and sea-breezes, may be accounted for upon the above principle: the heated rarified land air rises, and its place is supplied by the chill damp air from the surface of the sea; that from the hills in the neighbourhood becoming cold and dense in the course of the night, descend and press upon the comparatively lighter air over the sea, and hence the land breeze. Granting that the attraction of the moon, and the diurnal movement of the sun, affects our atmosphere, there cannot be a doubt but a westward motion of the air must prevail within the boundaries of the trade winds, the consequence of which is an easterly current on each side: from this then it proceeds that south-west winds are so frequent in the western parts of Europe, and over the Atlantic ocean. Mr. Kirwan attributes our constant south-west winds, particularly during winter, to an opposite current prevailing between the coast of Malabar and the Moluccas at the same period: this, he adds, must be supplied from regions close to the pole, "which must be recruited in its turn from the countries to the south of it in the western parts of our hemisphere."

The variable winds cannot be so readily accounted for, yet it is evident that, though they seem the effect of capricious causes, they depend upon a regular system, arranged by the great author of nature. That accurate and successful observer of part of his works, the celebrated Franklin, discovered in 1740 that winds originate at the precise point towards which they blow. This philosopher had hoped to observe an eclipse of the moon at Philadelphia, but was prevented by a north-east storm, that commenced at seven in the evening. This he afterwards found did not occur at Boston till eleven; and upon enquiry he had reason to suppose it passed to the north-east at the rate of about 100 miles an hour. The manner in which he accounts for this retrograde proceeding is so satisfactory, that we shall give it in his own words, particularly as his assertions are supported by recent observations both in America and Scotland. He argued thus: "I suppose a long canal of water, stopped at the end by a gate. The water is at rest till the gate is opened; then it begins to move out through the gate, and the water next the gate is first in motion, and moves on towards the gate; and so on successively, till the water at the head of the canal is in motion, which it is last of all. In this case all the water moves indeed towards the gate; but the successive times of beginning the motion are in the contrary way, viz. from the gate back to the head of the canal. Thus, to produce a north-east storm, I suppose some great rarefaction of the air in or near the Gulph of Mexico; the air rising thence has its place supplied by the next more northern, cooler, and therefore denser and heavier air; a successive current is formed, to which our coast and inland mountains give a north-east direction." According to the observations made by Captain Cook, the north-east winds prevail in the Northern Pacific Ocean during the same spring months they do with us,

[illegible] Pacific and Atlantic [illegible]

[illegible] words may [illegible] As the at[illegible] and [illegible] frequently [illegible] with [illegible] and the reverse [illegible] degrees [illegible]

[illegible] There are [illegible] an artificial [illegible] are not [illegible] marks [illegible] they belong.

METHODISTS. The term Methodist [illegible] [illegible] and had [illegible]

[illegible] Rome against the attacks of the Protestants. This sect is now far more, and the appellation is made to designate the followers of the late Messrs. John and Charles Wesley, and the societies formed by the Rev. George Whitefield. They are divided into Whitefieldian and Wesleyan Methodists. The members of the former division embrace the doctrines of Calvin; the latter, as far as relates to Free-will, are Arminians. For an account of the doctrines held by the Whitefieldian Methodists, see article CALVINISTS.

The following are the doctrines held by the Arminians or Wesleyan Methodists: 1. Justification by Faith only; by which they mean not only our acquittal at the last-day, but present forgiveness, pardon of sins, and consequently acceptance with God.

2. They maintain, that the condition of justification is faith and hold, that not only without faith no one can be saved, but also, that as soon as any one has true faith, in that moment he is justified: this is called the New Birth. It should be understood, that this doctrine of justification by faith only, includes in it also the notion of the witness of the spirit: that is, according to the Methodists, an instantaneous, sensible impression, or "comfortable assurance," in the mind of the sinner, that his sins are forgiven, and that he stands justified before God; but on this part of the doctrine there appears to be a difference of opinion among them. At the conference held in 1806, Mr Joseph Cooke was expelled from the connection because he had taught, in two sermons, which he published, "that in what ever moment a sinner returns to God, according to the requisitions of the gospel, God accepts that sinner, and his wrath no longer abides upon him, or, in other words, that the sinner is justified; and that, whether he has any comfortable persuasion of it in his own mind, or not." For this, though he offered to prove that he had taught nothing which is not contained in the writings of Wesley and Fletcher, Mr. Cooke was condemned unheard. "What," however, "he was not allowed to prove before the conference, he has since proved before the world. See his late publication, intitled "Methodism condemned by Methodist Preachers, &c."

3. They maintain, that though good works cannot go before, yet they must always follow justifying faith.

4. They believe that it is the duty and privilege of all true believers to attain to a state of perfection, or, as they sometimes express it, entire sanctification, before they leave this life. This is a favourite doctrine with the Wesleyan Methodists. It is thus described: "they believe that Christians may, nay ought to attain to a state of moral perfection before death; and that this may be attained in a moment, just as they received the forgiveness of their sins. This work they assign chiefly to the third person in the Trinity, who is said to commence his cleansing operations the moment he speaks peace to the soul by the absolution of the sinner; and that he, the Holy Ghost, silently, and sometimes almost imperceptibly, proceeds to work on the remains of inbred sin, till, in a moment, the

old man with his deeds is wholly put off, and the soul is purged from every stain, not having spot or wrinkle, or any such thing. This state of perfection needs never be lost." Mr. Wesley asserted, that there is a state of sanctification from which the believer can never fall. It is proper to remark, that the Methodists believe all the leading doctrines of other orthodox Christians, as far as relates to original or birth-sin, the Trinity, atonement, or the vicarious sacrifice of Christ, the eternity of hell torments, &c. They differ, however, from the Whitefieldian Methodists concerning predestination, irresistible grace, imputed righteousness, the final perseverance of the saints, election, and reprobation.

The Wesleyan Methodists are incorporated into a regular and compact body, and have adopted a system of church-government which has a wonderful tendency to unite the members to each other. Their meetings for worship and for business are of various kinds, and are distinguished into prayer-meetings, class-meetings, band-meetings, watch-nights, love-feasts, yearly-covenants, quarterly-meetings, district-meetings, and annual conferences. Their church officers are denominated travelling preachers, who are divided into superintendants and helpers; local preachers, who follow some secular employment, and never travel; class leaders, prayer leaders, or exhorters; band-leaders, trustees, and stewards. For the more easy management and union of the whole connection, the kingdom is divided into districts, comprehending generally three, four, or more circuits, the whole being under the immediate superintendance of the conference, which is assembled annually, and consists of one hundred travelling preachers, at first nominated in the will of the late Rev. John Wesley, their numbers being regularly filled up by ballot.

Soon after the death of Mr. John Wesley, his people began to be divided with respect to discipline. Notwithstanding his professed attachment to the church of England, he suffered himself, towards the latter part of his life, to be persuaded to ordain some of his preachers bishops, and priests! this produced a great sensation throughout the societies; and it was thought that he wished a regular ordination to take place at some future opportunity. At the first conference after his death, the preachers published a declaration, in which they avowed their determination to "take up the *plan* as Mr. Wesley had left it." This was by no means satisfactory to many of the junior preachers and people. Several pamphlets were published, tending to demonstrate the justness of the claim, that a plan of perfect equality and religious liberty, ought to be extended to all the societies. These disputes at length produced what was called *a plan of pacification*, in which it was decided—by ballot! that in every place where a three-fold majority of class-leaders, stewards, and trustees, desired it, the people should have preaching in church-hours, and the sacraments of baptism and the Lord's Supper administered to them.

The spirit of investigation being excited, did not terminate here; for it soon began to be discovered that the people ought to have a voice in the temporal concerns of the societies, vote in the election of church-officers, and give their suffrages in spiritual concerns. Numerous pamphlets were published on these subjects. The leading man on the side of the people was the late Mr. Alexander Kilham, who had been many years a travelling preacher, and was much respected for his zeal and activity in the cause of religious liberty. He was expelled the connection for publishing a work, intitled "The Progress of Liberty among the People called Methodists."

At the Leeds conference, in 1797, there were delegates from many societies, in various parts, who were instructed to request that "the people might have a voice in the formation of their own laws, the choice of their own officers, and the distribution of their own property." Their requests were refused; and a motion that delegates from the people might be permitted to have seats in the yearly conference being negatived, all hopes of accommodation between the people and the leading preachers were cut off. Immediately a new plan of church-government was proposed, and on it was founded a system of Methodism, denominated The New Connection. This plan was organized and supported by Mr. William Thom, an old travelling preacher, Mr. Alexander Kilham, and Mr. John Grundell, a blind gentleman, of considerable talents, and unimpeachable integrity.

The preachers and people of the new connection, sometimes called Kilhamites, are incorporated in all meetings for business. Their plan of church-government is laid down in a small pamphlet, intitled "General Rules of the United Societies of Methodists in the New Connection."

The following is given as an accurate statement of the number of preachers and

people in the Wesleyan connection of Methodists, at the close of the sixty-third annual conference, held in August 1806:

In Great Britain		110,803
In Ireland		23,773
Gibraltar		40
Nova Scotia, New Brunswick, and Newfoundland		1,418
West India—Whites	1,775	14,940
Coloured people, &c.	13,165	
United States—Whites	95,628	119,944
Coloured people, &c.	24,316	
Total		270,918

In addition to these may be added about 100,000 adult hearers—Methodists in religious sentiment; though, from various causes, prevented from formally joining the societies. To these still further may be added about 218,000 more, composed of the younger branches of families, and those generally influenced by the Methodist doctrines. About 6,000 more may be added, from Methodists who, from some slight difference as to discipline, &c. have formed themselves into independent societies in various parts of the United Kingdoms: not now to reckon the Methodists of the New Connection. It appears from the report of the last conference, held at Liverpool, in July 1807, that an increase of 8,492 members had then been made to the society in these kingdoms since the preceding conference. At the conference held by the Methodists of the New Connection, in May 1807, their number was 6,428. They have had an increase, we understand, of about 700 since that period. It appears, therefore, that the total number of Arminian Methodists amount to about 619,538. The Calvinian Methodists are doubtless equally numerous. The local and travelling preachers, belonging to the different Methodist societies, amount to about 1,650. For a very impartial and minute history of the rise and present state of this sect, see the Rev. J. Nightingale's "Portraiture of Methodism." Two pamphlets on the subject of Methodim have also been lately published, which have excited considerable interest, and deserve to be generally circulated, entitled, "Hints to the Public and the Legislature, on the Nature and Effects of Evangelical Preaching." By a Barrister. Replies to the first of these pamphlets have been published by Dr. Hawker and others. The periodical publications conducted by the Methodists are numerous, and have an astonishing circulation. Of the Methodist Magazine about twenty thousand copies are sold monthly; of the Evangelical Magazine about twenty-two thousand. The sale of the Eclectic Review, in the same interest, appears, by a circular letter lately printed, signed by several preachers both of the Arminian and Calvinian Methodists, to be very limited. The Methodists have also in their interest a weekly newspaper, called "The Instructor." The number of small tracts and pamphlets sold and given away by the Methodists is incredible; and they are indefatigable in their attempts to convert the Mahometans and the Heathen to their way of thinking.

METRE, in poetry, a system of feet of a just length.

The different metres in poetry are the different manners of ordering and combining the quantities, or the long and short syllables: thus hexameter, pentameter, iambic, sapphic verses, &c. consist of different metres or measures.

In English verses, the metres are extremely various and arbitrary, every poet being at liberty to introduce any new form that he pleases. The most usual are the heroic, generally consisting of five long and five short syllables, and verses of four feet, and of three feet, and a cæsura, or single syllable.

The ancients, by variously combining and transposing their quantities, made a vast variety of different measures, by forming spondees, &c. of different feet. See Foot.

METROSIDEROS, in botany, a genus of the Icosandria Monogynia class and order. Natural order of Myrti. Essential character: calyx five-cleft, half superior; petals five; stamina very long, standing out; stigma simple; capsule three-celled. There are thirteen species, of which M. hispida is a very magnificent plant, easily distinguished by its broad sessile leaves, and hispid branches; the flowers are yellow, with wide spreading stamens growing in umbels, many of which unite to form a large terminating corymb, rough, with red-brown hairs. This plant is common in most collections about London: it has not yet flowered. It was found at Port Jackson, in New South Wales, by Mr. White.

MEZZOTINTO, a particular manner of representing figures on copper, so as to form prints in imitation of painting in Indian ink.

The manner of making mezzotintos is

very different from all other kinds of engraving and etching, since, instead of forming the figures with lines and scratches made with the point of a graver, or by means of aqua fortis, they are wholly formed by scraping and burnishing. Mezzotintos are made in the following manner: take a well-polished copper-plate, and, beginning at the corner, rake or furrow the surface all over with a knife or instrument made for the purpose, first one way, and then the other, till the whole is of a regular roughness, without the least smooth part to be seen; in which state, if a paper was to be worked off from it at the copper-plate press it would be all over black. When this is done, the plate is rubbed over with charcoal, black chalk, or black lead, and then the design is drawn with white chalk, after which the out-lines are traced out, and the plate finished by scraping off the roughness, so as to leave the figure on the plate. The out-lines and deepest shades are not scraped at all, the next shades are scraped but little, the next more, and so on, till the shades gradually falling off, leave the paper white, in which places the plate is neatly burnished.

By an artful disposition of the shades, and different parts of a figure on different plates, mezzotintos have been printed in colours, so as nearly to represent very beautiful paintings.

MICA, in mineralogy, a species of the Clay genus, is commonly of a grey colour, passing into brown and black. It occurs disseminated in thin tables and layers in other stones, also crystallized. It feels smooth, but not greasy. Specific gravity about 2.8 or 2.9. It may be converted by the blow-pipe into a white enamel, and it consists, according to Kirwan, of

Silica	38
Alumina	28
Oxide of iron	14
Magnesia	20
	100

By an analysis of Vauquelin, the difference is very considerable, as will be seen.

Silica	50
Alumina	35
Oxide of iron	7
Magnesia	1.35
Lime	1.33
	94.68
Loss	5.32
	100

Mica is one of the constituent parts of granite, gneiss, and mica-slate; it is also found in syenite, porphyry, and wacce, in almost every part of the world. It was formerly used for windows and lanterns, instead of glass, and in the Russian navy it is still used for the same purpose, being, on account of its elasticity, less liable to break than glass, on the discharge of cannon. Mica, used by the Russians, is dug up in Siberia.

MICHAUXIA, in botany, so named in memory of Andrew Michaux, botanist; a genus of the Octandria Monogynia class and order. Natural order of Campanaceæ. Campanulaceæ, Jussieu. Essential character: calyx sixteen-parted; corolla wheel-shaped, eight-parted; nectary eight-valved, staminiferous; capsule eight-celled, many-seeded. There is but one species, *viz.* M. campanuloides, rough-leaved michauxia: this is a handsome biennial plant, having the habit of a campanula; it has a simple stem, panicled when in flower; upright, herbaceous, rough-haired, green, two feet high; root-leaves petioled, cordate; stem-leaves half embracing, lanceolate; flowers in a panicle, peduncled, bracted, hanging down. It is a native of Aleppo.

MICHELIA, in botany, so named in honour of Pietro Antonio Micheli of Florence; a genus of the Polyandria Polygynia class and order. Natural order of Coadunatæ. Magnoliæ, Jussieu. Essential character: calyx three-leaved; petals fifteen; berries many, four-seeded. There are two species, natives of the East Indies.

MICROMETER, an instrument usually fitted to a telescope, in the focus of the object-glass, for measuring small angles or distances, as the apparent diameter of the planets. The general principle of this instrument is, that it moves a fine wire, parallel to itself, in the plane of the picture of an object, formed in the focus of a telescope, and thus measures its perpendicular distance from a fixed wire in the same plane.

This instrument was invented about the year 1666; and it has, of course, undergone many improvements since that time. Dr. Gascoigne divided the image of an object, in the focus of the object-glass, by the approach of two pieces of metal, ground to a very fine edge; instead of which, Dr. Hook would substitute two fine hairs, stretched parallel to each other: and two other methods of Dr. Hook, different from this, are described in his posthumous works. An

[illegible] curious observations [illegible] made by the help of [illegible] particularly in measuring [illegible] of the moon and other planets, [illegible] seen in the Philosophical Transactions, Vol. xlviii.

De la Hire, in a discourse on the æra of the inventions of the micrometer, pendulum clock, and telescope, read before the Royal Academy of Sciences in 1717, makes M. Huygens the inventor of the micrometer. That author, he observes, in his "Observations on Saturn's Ring, &c." published in 1659, gives a method of finding the diameters of the planets by means of a telescope, viz. by putting an object, which he calls a virgula, of a size proper to take in the distance to be measured, in the focus of the convex object glass: in this case, says he, the smallest object will be seen very distinctly in that place of the glass. By such means, he adds, he measured the diameter of the planets as he there delivers them.

De la Hire says, that there is no method more simple or commodious for observing the digits of an eclipse, than a net in the focus of the telescope. These, he says, were usually made of silken threads; and for this particular purpose six concentric circles had also been used, drawn upon oiled paper; but he advises to draw the circles on very thin pieces of glass, with the point of a diamond. He also gives some particular directions to assist persons in using them. In another memoir, he shews a method of making use of the same net for all eclipses, by using a telescope with two object-glasses, and placing them at different distances from each other.

M. Cassini invented a very ingenious method of ascertaining the right ascensions and declinations of stars, by fixing four cross hairs in the focus of the telescope, and turning it about its axis so as to make them move in a line parallel to one of them. But the later improved micrometers will answer this purpose with greater exactness. Dr. Maskelyne has published directions for the use of it, extracted from Dr. Bradley's papers, in the Philos. Trans. Vol. lxi.

Dr. Derham tells us that his micrometer is not put into a tube, as is usual, but is contrived to measure the species of the sun on paper, of any radius, or to measure any part of them. By this means he can easily, and very exactly, with the help of a fine thread, take the declination of a solar spot at any time of the day, and, by his half-seconds watch, measure the distance of the [illegible] either limb of the sun.

J. A. Segner proposed to enlarge the field of view in these micrometers, by making them of a considerable extent, and having a moveable eye-glass, or several eye-glasses, placed opposite to different parts of it. He thought, however, that two would be quite sufficient, and he gives particular directions how to make use of such micrometers in astronomical observations.

A considerable improvement in the micrometer was communicated to the Royal Society, in 1743, by Mr. S. Savary; an account of which, extracted from the minutes by Mr. Short, was published in the Philos. Trans. for 1753. The first hint of such a micrometer was suggested by M. Roemer in 1675: and M. Bouguer proposed a construction similar to that of M. Savary in 1748. The late Mr. Dolland made a further improvement in this kind of micrometer, an account of which was given to the Royal Society by Mr. Short, and published in the Philos. Trans. Vol. xlviii. Instead of two object glasses he used only one, which he neatly cut into two semicircles, and fitted each semi-circle in a metal frame, so that their diameters sliding in one another, by means of a screw, may have their centres so brought together as to appear like one glass, and so form one image; or by their centres receding, may form two images of the same object: it being a property of such glasses, for any segment to exhibit a perfect image of an object, although not so bright as the whole glass would give it. If proper scales are fitted to this instrument, shewing how far the centres recede, relative to the focal length of the glass, they will also shew how far the two parts of the same object are asunder, relative to its distance from the object-glass; and consequently give the angle under which the distance of the parts of that object are seen. This divided object glass micrometer, which was applied by the late Mr. Dolland to the object end of a reflecting telescope, and has been with equal advantage adapted by his son to the end of an achromatic telescope, is of so easy use, and affords so large a scale, that it is generally looked upon by astronomers as the most convenient and exact instrument for measuring small distances in the heavens. However, the common micrometer is peculiarly adapted for measuring differences of right ascension, and declination of celestial objects, but less convenient and exact for measuring their absolute distances, whereas the object glass micrometer is peculiarly fitted for measuring distances, though generally supposed

improper for the former purpose. But Dr. Maskelyne has found that this may be applied with very little trouble to that purpose also; and he has furnished the directions necessary to be followed when it is used in this manner. The addition requisite for this purpose is a cell, containing two wires, intersecting each other at right angles, placed in the focus of the eye-glass of the telescope, and moveable round about by the turning of a button. For the description of this apparatus, with the method of applying and using it, see Dr. Maskelyne's paper on the subject, in the Philos. Trans. Vol. lxi.

After all, the use of the object-glass micrometer is attended with difficulties, arising from the alterations in the focus of the eye, which are apt to cause it to give different measures of the same angle at different times. To obviate these difficulties, Dr. Maskelyne, in 1776, contrived a prismatic micrometer, or a micrometer consisting of two achromatic prisms, or wedges, applied between the object-glass and eye-glass of an achromatic telescope, by moving of which wedges nearer to or further from the object-glass, the two images of an object produced by them appeared to approach to, or recede from, each other, so that the focal length of the object-glass becomes a scale for measuring the angular distance of the two images. The rationale and use of this micrometer are explained in the Philos. Trans. vol. lxvii.

Mr. Ramsden has described two new micrometers, which he has contrived for remedying the defects of the object-glass micrometer. One of these is a catoptric micrometer, which, besides the advantage it derives from the principle of reflection, of not being disturbed by the heterogeneity of light, avoids every defect of other micrometers, and can have no aberration, nor any defect arising from the imperfection of materials, or of execution; as the great simplicity of its construction requires no additional mirrors or glasses, to those required for the telescope; and the separation of the image being effected by the inclination of the two specula, and not depending on the focus of lens or mirror, any alteration in the eye of an observer cannot affect the angle measured. It has peculiar to itself the advantages of an adjustment, to make the images coincide in a direction perpendicular to that of their motion; and also of measuring the diameter of a planet on both sides of the zero; which will appear no inconsiderable advantage to observers who know how much easier it is to ascertain the contact of the external edges of two images than their perfect coincidence.

The other micrometer invented and described by Mr. Ramsden, is suited to the principle of refraction. This micrometer is applied to the erect eye-tube of a refracting telescope, and is placed in the conjugate focus of the first eye-glass, as the image is considerably magnified before it comes to the micrometer, any imperfection in its glass will be magnified only by the remaining eye-glasses, which in any telescope seldom exceeds 5 or 6 times; and besides, the size of the micrometer glass will not be the 100th part of the area which would be required, if it were placed at the object-glass; and yet the same extent of scale is preserved, and the images are uniformly bright in every part of the field of the telescope. See Philos. Trans. Vol. lxix.

In the Philos. Trans. for the year 1782, Dr. Herschel, after explaining the defects and imperfections of the parallel-wire micrometer, especially for measuring the apparent diameter of stars, and the distances between double and multiple stars, describes one for these purposes, which he calls a lamp micrometer; one that is free from such defects, and has the advantage of a very enlarged scale. In speaking of the application of this instrument, he says, "It is well known to opticians, and others, who have been in the habit of using optical instruments, that we can with one eye look into a microscope, or telescope, and see an object much magnified, while the naked eye may see a scale upon which the magnified picture is thrown. In this manner I have generally determined the power of my telescopes; and any one who has acquired a facility of taking such observations, will very seldom mistake so much as one in fifty in determining the power of an instrument, and that degree of exactness is fully sufficient for the purpose.

"The Newtonian form is admirably adapted to the use of this micrometer, for the observer stands always erect, and looks in a horizontal direction, notwithstanding the telescope should be elevated to the zenith. The scale of the micrometer at the convenient distance of 10 feet from the eye, with the power of 460, is above a quarter of an inch to a second; and by putting on my power of 932 I obtain a scale of more than half an inch to a second, without increasing the distance of the micrometer;

[illegible] former micrometers, with [illegible] instrument, and a [illegible] of less than the [illegible] part of an inch to a second.

"The [illegible] of this micrometer are not confined to double stars only, but may be applied to any other objects that require the utmost accuracy, such as the diameters of the planets or their satellites, the mountains of the moon, the diameters of the fixed stars, &c."

We shall now give an account of a micrometer by Mr. Troughton, which is applied to the eye-piece of a telescope to measure exceedingly small angles, as the diameter of the heavenly bodies, &c. Plate Microscope, &c. fig. 6. is an orthography projecting endways, fig. 7. a section of the box containing the wires; and, fig. 8. a section lengthways: the same letters, as far as they can, are used in all the figures. Figs. 6 and 8. A is an eye-tube containing a convex lens at each end, this slides in another tube, *c d*, so as to adjust the glass to distinct vision of the wires; the tube, *c d*, is screwed into another, *b b*, which is much larger, through this a thin long box, D D D, containing the wire slides. The micrometer is screwed to the telescope by a male screw, *e e*, (fig. 8.) in the same piece with which is a circular plate, *f f*, cut all round with fine teeth, this plate fits against the flat bottom of the box, *b*, and turns round concentrically with it by means of a ring, *k*, fitting into a conical hole in the centre of the plate, *f f*, and screwed to the box; a small endless screw, *h*, (fig. 6.) turning in two brass collars screwed to the box, *b*, works in the teeth cut round the plate, *f*, and by that means when the milled head on the arbor of the endless screw is turned, it turns the eye-tube and box, D D, round, to bring it to any convenient position for measuring the angles required; the box containing the wires is shewn open in fig. 7, it containing two frames, *h h h*, and *l l l*, one sliding within another, which moves in the box, without lateral shake, yet fitted so as to slide easily backwards and forwards in the box, by the screws, *m* and *n*, in the same manner as the microscope in the upper part of the same plate, *o* and *p* are springs to counteract the screws and make the motion pleasant. A wire is stretched across the frame, *h h*, at right angles to its sides, and another of the same size is fixed across the slider, *l l l*, exactly parallel to the former: a small quantity of the underside of the latter is cut away, and its wire is fixed in another plane to the wire of *h h h*, so that the wires can pass each other without touching, but as near as possible; when they are placed by their screws over each other, and viewed through the eye-tube, they appear but as one wire: the divided circle, *x*, on the nuts of screws are then slipped round, without the screw, to bring the first division on them to the index *l*; the instrument is now adjusted for observing any angle, it is screwed to the telescope, and by the endless screw, *h*, (fig. 6.) the micrometer is turned round so as to bring a fixed wire, *w*, which is perpendicular to the others, to cover the two objects; the two wires are then separated by turning either of the nuts, F, until the wires include the angle to be measured: the whole box (fig. 7.) of the micrometer slides through the tube, in the direction of its length, to follow any moving object. When the observation is completed it is read off by a scale of notches in the box, (fig. 7.) determining the number of revolutions the screw has made, and the divisions pointed out on the circles, *x*: by the indexes, *l l*, the number of aliquot parts is denoted; the circular plate, *f f*, is divided into degrees as shewn in fig. 6, and it is by this that the angle line measured makes with the horizon is registered.

The circles are divided in 100 parts, and have no determinate value in angular measurement, but their value is determined experimentally by observing through the telescope, it is applied to the diameter of the sun, or any other body whose angular measure has been previously and accurately determined by some other divided instrument, and from this the angle given by each observation is calculated.

The micrometer has not only been applied to telescopes, and employed for astronomical purposes; but there have been various contrivances for adapting it to microscopical observations. M. Leeuwenhoek's method of estimating the size of small objects, was by comparing them with grains of sand, of which 100 in a line took up an inch. These grains he laid upon the same plate with his objects, and viewed them at the same time. Dr. Jurin's method was similar to this; for he found the diameter of a piece of fine silver wire, by wrapping it very close upon a pin, and observing how many rings made an inch: and he used this wire in the same manner as Leeuwenhoek used his sand. Dr. Hook used to look upon the magnified object with one eye, while, at the same time, he viewed other objects, placed at the same distance, with the other

eye. In this manner he was able, by the help of a ruler, divided into inches and small parts, and laid on the pedestal of the microscope, as it were to cast the magnified appearance of the object upon the ruler, and thus exactly to measure the diameter which it appeared to have through the glass; which being compared with the diameter as it appeared to the naked eye, easily shewed the degree in which it was magnified. A little practice, says Mr. Baker, will render this method exceedingly easy and pleasant.

Mr. Martin, in his Optics, recommends such a micrometer for a microscope as had been applied to telescopes; for he advises to draw a number of parallel lines on a piece of glass, with the fine point of a diamond, at the distance of one-fortieth of an inch from one another, and to place it in the focus of the eye-glass. By this method Dr. Smith contrived to take the exact draught of objects viewed by a double microscope; for he advises to get a lattice, made with small silver wires or squares, drawn upon a plain glass by the strokes of a diamond, and to put it into the place of the image formed by the object-glass. Then, by transferring the parts of the object, seen in the squares of the glass or lattice, upon similar corresponding squares drawn on paper, the picture may be exactly taken. Mr. Martin also introduced into compound microscopes another micrometer, consisting of a screw.

A very accurate division of a scale is performed by Mr. Coventry, of Southwark. The micrometers of his construction are parallel lines drawn on glass, ivory, or metal, from the 10th to the 10,000th part of an inch. These may be applied to microscopes for measuring the size of minute objects, and the magnifying power of the glasses; and to telescopes for measuring the size and distance of objects, and the magnifying power of the instrument. To measure the size of an object in a single microscope, lay it on a micrometer whose lines are seen magnified in the same proportion with it, and they give, at one view, the real size of the object. For measuring the magnifying power of the compound microscope, the best and readiest method is the following: On the stage, in the focus of the object-glass, lay a micrometer, consisting of an inch divided into 100 equal parts, count how many divisions of the micrometer are taken into the field of view; then lay a two-foot rule parallel to the micrometer; fix one eye on the edge of the field of light, and the other eye on the end of the rule, which move till the edge of the field of light and the end of the rule correspond; then the distance from the end of the rule to the middle of the stage will be half the diameter of the field. *Ex. gr.* If the distance be 10 inches the whole diameter will be 20, and the number of the divisions of the micrometer contained in the diameter of the field is the magnifying power of the microscope.

Mr. Adams has applied a micrometer that instantly shews the magnifying power of any telescope.

In the Philos. Trans. for 1791, a very simple scale micrometer, for measuring small angles with the telescope, is described by Mr. Cavallo. This micrometer consists of a thin and narrow slip of mother-of-pearl finely divided, and placed in the focus of the eye-glass of a telescope, just where the image of the object is formed; whether the telescope is a reflector or a refractor, provided the eye-glass be a convex lens. This substance, Mr. Cavallo, after many trials, found much more convenient than either glass, ivory, horn, or wood, as it is a very steady substance, the divisions very easy marked upon it, and when made as thin as common writing paper it has a very useful degree of transparency.

MICROPUS, in botany, a genus of the Syngenesia Polygamia Necessaria class and order. Natural order of Compositæ Nucamentaceæ. Corymbiferæ, Jussieu. Essential character: calyx calicled; ray of the corolla none: female, florets wrapped up in the calycine scales; down none; receptacle chaffy. There are two species, viz. M. supinus, trailing micropus; and M. erectus, natives of Spain and the Levant.

MICROSCOPE, in optics. By microscopes are understood instruments of whatever structure or contrivance, that can make small objects appear larger than they do by the naked eye. This is effected by means of convex glasses. When only one convex glass or lens is used, the instrument is called a single microscope; but if two or more are employed conjointly to magnify objects, it is then called a double or compound microscope. When objects are seen through a perfectly flat glass, the rays of light pass through it from them to the eye, in a straight direction, and parallel to each other, and consequently the objects appear very little either diminished or enlarged, or nearer or further off than to the naked eye. But if the glass through which

[illegible] the glass, [illegible] a greater distance [illegible] the glass [illegible] convex. The point where the rays meet, is called [illegible] which is nearer or further according to the convexity of the glass; for a small degree of convexity throws it to a [illegible] distance, when the convexity [illegible] the focus is near. The magnifying power [illegible] the convexity [illegible] at [illegible] the [illegible] distance, the less it [illegible] nearer its [illegible] magnifying power. We [illegible] Optics for a more particular account [illegible] proceed to describe the instrument of which we have [illegible] drawings. Plate Microscope, &c.

The body of the microscope, A A, being a large tube, is supported by brass pillars, [illegible] from a wooden pedestal [illegible] which pedestal is a drawer to hold the [illegible] glasses and other parts of the apparatus; a [illegible] slides into the greater, and is moved up and down therein by a rack and pinion turned by a milled-headed [illegible] this tube is [illegible] the body of the microscope, as shewn in the section fig. [illegible] and moving up and down with it [illegible] its bottom [illegible] much [illegible] with a male screw [illegible] [illegible] wherein to screw the [illegible] glasses, or magnifiers: there are five of [illegible] [illegible]

[illegible] The greatest [illegible] the smallest apertures [illegible] L is a circular plate of brass [illegible] between [illegible] the centre [illegible] M [illegible] [illegible] fig. 4 [illegible] objects are placed [illegible] of [illegible] steel [illegible] three brass circles [illegible] for the admission of [illegible] Q is a concave mirror set in a box of brass, and turning in an arch, R, upon two small screws. From the bottom of the arch [illegible] which being let down into a [illegible] pedestal, enables it [illegible] horizontally, and reflect the [illegible] of a candle or the sky, directly [illegible] the object to be viewed. V, is a plano-convex lens, which, by turning out two screws when the pin at the bottom of it is placed in the hole made for its reception in the circular plate, L, will transmit the light of a candle to illuminate any opaque object that is put on the round piece of ivory, or on ebony, for examination, and it may be moved higher or lower as the light requires: this glass is useful to point the sunshine, or the light of a candle, upon any opaque object; but in plain daylight is of no great use. The brass fish pan, fig. [illegible] is to fasten a smelt, gudgeon, or any such small fish upon, to see the blood circulate in its tail; for which purpose, the tail of a fish must be spread across the oblong hole, or the end of the pan, by slipping the button on the backside of the pan into a slit through the circular plate, L. A spring that is beneath the plate presses the button, and will make it steady, and present it well; but if it be a frog, a newt, or eel, in which the circulation is desired to be shewn, a glass tube, fig. 6, is fittest for the purpose. The tail of a newt, or eel, or, in a frog, the web between the toe of the hind-feet, are the parts where it may be seen best. When the object is well expanded on the inside of the tube, slide the tube along under the circular brass plate, L, where there are two springs and a cavity made in the stalk to hold it, and bring the object directly under the magnifier.

There are three of these glass tubes, smaller [illegible] than another, and the size of the object must direct which to use; but, [illegible] the less room the creature has [illegible] the easier it may be magnified, and the quieter it will lie to be examined. [illegible] glasses, viz. one plain, and two concave, belong also to the microscope, and are designed to confine objects, or [illegible] upon occasionally.

The [illegible] with a pair of [illegible] at a nob of ivory at the [illegible] to hold fast, or lay objects on [illegible] backwards [illegible] in a short brass tube, which [illegible] is fastened, which fits [illegible] the edge of the brass plate L, and then the object may be readily [illegible] and a light be cast upon it, either by the looking glass underneath, or, if it be opaque, by the plano-convex lens, N.

L, fig. 4, is a flat piece of ivory, called a

slider, with four round holes through it, and objects placed in them, between Muscovy talcs, or isinglass, kept in by brass wires.

It is proper to have a number of these sliders filled with curious objects, always ready, as well as some empty ones, for any new thing that offers. When made use of, thrust them between the brass rings of the contrivance on purpose for them, as shewn in fig. 4, which shoots into the round hole M, in the centre of the brass plate, L; this keeps them steady, and, at the same time, permits them to be moved to and fro for a thorough examination.

The upper part of Plate Microscope, &c. describes the construction of a microscope, used for observing the divisions on mathematical instruments, and subdividing them into smaller portions. The drawing was made from one of those used by Mr. Troughton in his instruments; and the position of four of them are shewn in the drawing of one of his astronomical circles, see Circular Instrument, fig. 1, an elevation sideways of the microscope; fig. 2, a section in the same direction; fig. 3, a section endways, and four and five parts shewn separately.

The microscope is fixed to the instrument it is applied to, by two nuts, *a a*, figs. 1 and 2, which work upon a male screw, cut on the external tube; these nuts have a smaller part turned upon them, which exactly fit into a circular hole in a piece of brass fixed to the instrument, and by screwing the nuts tight, the microscope is fixed, as shewn in the drawing of the astronomical circle before referred to. B, fig. 1 and 2, is the sliding tube containing two convex lenses, *b d*, fig. 2, whose combined foci fall upon the wires to be hereafter described; this tube slides in another, D, screwed into a thin, square box, E, which contains the wires and screw, and it is shewn opened in fig. 3; it has a square frame, fig. 5, sliding in it; to this is affixed a very fine screw, which comes through the top of the box, and has a nut, F, screwed on it; at *e*, within the box, is a spring, formed of steel wire, acting upon the frame, fig. 5, so as to draw it into the box; by this the shoulder of the nut, F, is forced down upon the top of the box, and all shake or looseness in the motion prevented.

The frame has two exceedingly fine wires stretched across it, as in the figure, and it is by these the divisions on the instrument are observed: G is a conical tube, screwed into the principal tube of the instrument, with the object-glass at its end: the box, E, also contains a thin brass plate, fig. 4, which slides in it beneath the frame, fig. 5, and is moved when necessary by a small screw, *a*, going through the bottom of the box, whose action is counteracted by two thin slips of watch-spring, (seen in fig. 3); this plate has an oblong hole through it to see through, and on one side it is cut into fine notches, at such a distance apart that one turn of the nut, F, when viewed through the eye-tube, moves the cross wires in the frame, fig. 5, exactly one of these notches, and by that means the notches register the number of revolutions the nut has made. In adjusting and adapting this microscope to any instrument, the sliding eye-tube, B, is to be slid in or out of the tube, D, till the cross wire in the frame, fig. 5, are seen perfectly distinct. The microscope is then to be placed in such a position on the instrument it is applied to, that the line of divisions on the arc shall be parallel to the motion of the cross wires and frame, fig. 5, and screwed into its holder by the nuts, *a a*, (as shewn in the drawing of the circle) and the focus is adjusted so as to see the divisions on the arc distinctly, by turning these screws backwards or forwards, and moving the whole microscope nearer to, or further from the arc, until it is adjusted to distinct vision. The operator then looks through the microscope, and observes whether one division on the divided arc of the instrument answers to twenty of the notches of the scale, fig. 4, (which will each be then equal to one minute) if not the conical tube, G, containing the object-glass at its end, must be screwed in or out of the body of the microscope, until the image of the division or degree is lengthened or shortened, till it does, and a loose nut on the tube holds it at any place required; if this adjustment deranges the other before made for distinct vision, it must be rectified by the nuts, *a a*, and if this alters the space measured by the scale, fig. 4, the object-glass must be altered, and then again the nuts, *a a*, first one and then the other, until both adjustments of measure and distinct vision are perfect. The small screw which gives motion to the scale, fig. 4, is used to adjust it to the point of commencement on the circle or divided arc; or when two opposite microscopes are applied to the same circle, to adjust them so that they shall both read alike, that is, so that a line between them shall pass through the centre of the circle, and for the same purpose the small divided circle, *x*, of the nut, F, will slip round upon the nut

when required, without turning the screw to bring the first division upon it to the index, *l*, when the cross wires coincide with the point of commencement of the circle or divided arc.

For reading the divisions by this microscope, the middle notch of the scale, fig. 4, is accounted the first, and every fifth is denoted by a longer notch, and every tenth by a still longer, instead of figures. If now, when the circle is set to its required position, and observed through the microscope, any division or degree on the circle exactly coincides with the middle or first notch on the scale, the reading will be even degrees: if the division on the circle does not match with the first notch on the scale, the nut, F, of the screw must be turned, until the cross wires in the frame, fig. 5, exactly coincide with the division on the circle; the number of notches on the scale denotes the minutes, and the number of the division on the small circle, *x*, on the nut, F, which is opposite to the index, *l*, denotes the number of seconds. See Optics.

MICROTEA, in botany, a genus of the Pentandria Digynia class and order. Natural order of Oleraceæ. Atriplices, Jussieu. Essential character: calyx five-leaved, spreading; corolla none; drupe dry, echinated. There is only one species, *viz.* M. debilis, a native of the island of St. Christopher, in the West Indies.

MIDWIFERY. The art or science of assisting women in child-birth. Of late years, however, and especially in this country, since the Royal College of Physicians of London has consented to admit into a distinct class of its licentiates such, as upon examination, shall appear duly qualified for obstetric practice, it has become an art or science of more extensive range, and embraces every case connected with the female sexual system, as well as diseases of infancy during the period of lactation. Such being the general signification assigned in the present day, we shall contemplate the term under this sense, except what relates to the diseases of Infancy, already considered under that article, in the following sketch of its rise, progress, and practice.

HISTORY.

The history of midwifery may be comprised in a few words. In the earliest ages of life, when the manners were simple, the hours of rest and food regular, and the general strength and health proportionate, it was only in cases of mal-conformation, either of the mother or of the child, or mal-presentation of the latter, that any other assistance, perhaps, than what nature herself either gave or indicated, could be demanded. These exceptions, even in the present day of luxury, complex manners, and delicate health, are upon the whole extremely few compared with the general average of births that every hour is a witness to. Yet in the periods we are now contemplating, we know that they must have been very considerably fewer, because we know, that in every instance in which society, by its natural tendency, has overstepped the just medium of its prime object, and introduced soft and delicate habits, capricious fashions, and all the luxuries of refined life, it has at the same time introduced debility, even from birth, and often before birth, and consequently all those mal-conformations and obliquities from the line of health which naturally belong to mankind of both sexes, and which it is their own fault (we mean the fault of themselves or their ancestors) that they do not equally possess in every generation.

Hence the art of midwifery is coeval with civilized life, and is to be measured by its advance to the utmost summit of refinement. In the earliest ages, when nature required nothing more than mere co-operation with her common efforts, women alone, and these of no peculiar degree of skill, must have been altogether competent to the business of child-birth: and hence the midwives of the Hebrews, of the Greeks and Romans, we have reason to believe were all females; nor do we meet with a single instance of a chirurgical or medical practitioner having been had recourse to and actually employed earlier than the middle of the seventeenth century. Perhaps, among the earliest practitioners on the continent, we may mention M. Julian Clement, a surgeon of high reputation at Paris, who attended in a difficult case Madame de la Valiere, in 1663, and Dr. William Harvey among those of our own country, who published his celebrated treatise on generation a few years antecedently, and a few years afterwards engaged in the practice of midwifery, and followed up his practice with his *Exercitatio de partu*.

There can be no doubt that midwifery ought to have been studied and practised scientifically many ages before the period at which we have now arrived, and that the lives of thousands, as well of mothers as of children, must have fallen a sacrifice to the want of anatomical skill and knowledge.

upon this subject. Luxury, extravagance, and dissipation, were as common at Athens and Rome, during some periods of their history, as they have been in any part of Europe during the last two centuries; and though it is probable that the Athenian and Roman matrons, did not, from the fashion of their respective eras, run quite so readily as the ladies of the present day, into all the excesses of men, yet there can be no doubt that the example was contagious, and that the result, inregard to debility of frame, and consequently occasional mal-conformation of organs, if not equal in point of frequency and degree, could not have essentially varied. And in reality, had the Greek and Roman ladies been as correct and regular as possible in their own lives, yet from the necessity they must have been too frequently under of intermarrying with men of far less correctness and regularity, the female offspring hence ensuing could not fail to inherit much of the same kind of delicacy and debility of frame, and consequently misproportion of construction which we too frequently witness in the present day.

Still, however, it was the fashion to employ women, and none but women, in the momentous process of child-birth, notwithstanding the necessity of a contrary practice. Natural modesty, not always in league with fashion, gave additional force to the general custom, and imperious as was the call for the occasional employment of persons who had been regularly taught at the schools of anatomy, and had hence acquired a scientific knowledge of the organs concerned in gestation and labour, and of the changes they undergo during these respective processes,—life was in general rather to be sacrificed than a male practitioner of surgery to be resorted to. That the call for such assistance was imperious, we could adduce a thousand instances to prove, if it were necessary; we shall only observe, that Agnodice, a scholar of Hierophilus, in order to acquire a knowledge of this branch of anatomy, and finding herself prohibited, either by the common law of custom, or the written law of the state, from acquiring such knowledge in her own sex, consented to assume a male appearance, and for this purpose cut off her hair, exchanged her female for male attire, and in this disguise attended the lectures of this celebrated physician. She then publicly entered upon her profession; but another difficulty occurred to her, which was, that from the dress and appearance she had so long assumed, she was still suspected to be a man, notwithstanding she had returned to the common dress of her sex; and it was long before the prejudice thus excited was completely overcome.

On these accounts the art of midwifery made less improvement than any other branch of medicine. Hippocrates says but little upon the subject, and that little but very little to the purpose. He appears to have known of no other method of delivery, than by a presentation of the child's head; if any other part presented, he advises such part to be turned, and this not by an introduction of the hand of the practitioner into the uterus, but by shaking the mother, by making her jump repeatedly, or by rolling her on her bed; and if this do not succeed, to destroy the child and deliver it piecemeal. In the writings of Celsus, however, who flourished during the reign of Tiberius, we find hints that prove some advance had been made towards a more humane, scientific, and successful practice; for we are here told, that children may be safely and easily delivered in presentations of the feet as well as of the head, by taking hold of the legs, and dragging them downwards; as also, that if any other parts present than the head or feet, the child must be turned in the uterus by the introduction of the assistant's hand, so that one or the other of these organs be brought forwards into the vagina. We also meet with another piece of advice, which we are sorry to perceive has been of so long standing in the world, and which is very injudiciously praised and practised in the present day; and that is, that the practitioner ought to be perpetually striving to dilate the os tincæ or orifice of the womb, by the introduction of the fore finger alone, when the opening is only large enough to admit a single finger, smeared over with lard or pomatum; and that he should continue progressively to introduce two, three, or more fingers, and at length the whole hand as a general dilator to the orifice, so that the head, or whatever other part of the child presents, may the more readily pass through. Now it is comparatively very seldom that any benefit can be derived from this perpetual tampering; in some few cases of relaxed uteri, where the orifice is already sufficiently enlarged to allow three or four fingers to enter at once, and the pains at the same time are but feeble, or at least have but a small propulsive power, some advantage may be obtained, but none in any instance where the ori-

[illegible]

[illegible] appears by no [illegible] the pre- [illegible] an [illegible] and an excellent [illegible] profession, [illegible] the prac- [illegible] Hippocrates. In reality [illegible] the same kind of genera- [illegible] as late as to the middle of [illegible] century, for Riverius con- [illegible] in 16[illegible], and though Mau- [illegible] to it in his own practice, as [illegible] in his "Treatise on Mid- wifery," published in 1668, he tells us at [illegible] that many authors were of opinion, that in all [illegible] cases it would be better to attempt to turn the child than to deliver with such a presentation. So slow is the world to shake off a prejudice of any kind, when once deeply rooted, however unfounded or even fatal.

About this period several tracts or trea- tises on midwifery in Great Britain, issued from the pens of Wharton, Charleton, Mayow, and Raynold, of all which the last appears to have been the most celebrated writer. To the instrument called the crotchet, which had long been in use, but most commonly for removing the mangled limbs of the child, whom it was thought ne- cessary to destroy, we now find added, generally supposed to have been an inven- [illegible], a forceps of a peculiar kind, having a [illegible] resemblance to what is now [illegible]. The employ- ment of [illegible] [illegible], issued [illegible] Chamberlen, [illegible] Bramber, [illegible] instituted, and [illegible] [illegible] public [illegible] [illegible] midwifery [illegible] [illegible] It is useless to [illegible] this narrative any further, the [illegible] of

[illegible] Harvey, [illegible] and Deventer, [illegible] the profession, and by the world at large.

DISEASES OF THE FEMALE SEXUAL SYSTEM

From a cause that has never yet been ex- plained, women, on the commencement of puberty, throw forth, at monthly intervals, a peculiar and coloured fluid from the uterus, which forms a discharge [illegible], or only [illegible] during pregnancy and lactation, till the age of about forty-five in this country and others of a similar warmth, though the age at which it ceases is much earlier in countries of greater heat, and where the general form acquires a much earlier maturity. At the commencement of this natural or regular flow, which is usually denominated the menses or menstruation, women are often subject to many diseases from the change that takes place in the constitution at that period. They are sub- ject to other diseases from a morbid sup- pression, or too large or too frequent an evacuation of this discharge, and again to others, at the period of its final cessation.

We shall first examine into the nature of the menstrual fluid itself. It was formerly supposed that this fluid was a kind of sur- plus blood thrown out of the system from the mouths of minute veins. It has been clearly ascertained, however, by Dr. W. Hunter, that this fluid, whatever it be, is thrown from the mouths, not of the uterine veins, but the uterine arteries; and that instead of being blood, it has scarcely any one property in common with blood except- ing [illegible] in its colour. Generally speak- ing, the average time the discharge conti- nues is three or four days, and as to the pro- portional quantity lost on each day, on the first and fourth, or on the third day, the wo- man loses a[illegible] the quantity each day, and, on the [illegible] day, about the other half. The quantity lost will generally be [illegible] altogether, a single ounce on the first day, two on the second, and the [illegible] ounce on the third day. There is nothing, however, more af- fected by the climate than this: in a warm climate the quantity being increased, while it is diminished in cold ones. Linnæus, while writing his account of Lapland, says, that the quantity lost there is never above half an ounce [illegible]. In hot islands, as in those of the Archipelago, Hippocrates

writes, that the women lose twenty ounces of blood by this evacuation. Artificial warmth promotes the menstrual flux as powerfully as that of the sun.

The discharge, as we have already observed, commences with puberty, which varies exceedingly from climate. In Persia the females are fit for all the purposes of women at ten years old. In Lapland not till twenty. In our country about sixteen; and this period is characterized by certain attendant circumstances: the age of puberty is evinced by hair growing on the pubes and in the axillæ; the breasts are formed and made perfect; there is also a change in the ovaria.

The discharge when it earliest appears is not at first red, generally it is without colour. The succeeding periods are very regular, being every month, unless the woman lives in a state of nature, and falls with child, when, upon a pretty accurate calculation, she will menstruate about once in twenty months, if she suckle. Menstruation having begun will go on regularly unless interrupted by disease, or pregnancy, for a great number of years, generally till between the fortieth and fiftieth year; and the time of its cessation is generally regulated by the age at which it commenced. The final cessation of the menses may be known to be advancing by certain irregularities in the appearance: instead of the discharge lasting three, it will continue for ten days; nothing will then be seen for two months; next it may come once a fortnight, and then profusely. Menstruation appears to be a discharge intended to preserve the uterus in a state fitted for conception, for a girl cannot conceive till after the menses have appeared; nor does any woman conceive after they have ceased to flow.

So that woman only can become pregnant while the menses continue; and they appear to be more susceptible of conception immediately before and directly after them, than at any other part of the month. Also, in all animals there is a discharge somewhat analogous to it, which in them is called heat. This state is very nearly allied to it; and is well understood by boys, not one of whom when buying a doe rabbit will pay half the price for it, if not in heat, as if she be in heat: he has nothing to do, but by pressing with his thumb to invert a portion of the vagina, and if it be red and covered thickly with blood vessels, he knows it indicates heat, and is what he looks for; but if the vagina be smooth and white, every boy knows that he must keep that rabbit on bran and other expensive provisions for a month, before she will take the buck.

Menstruation may be the subject of disease from irregularity, obstruction, excess, or painful extrusion.

Irregular Menstruation. This may regard its time of accession, or cessation. It may be irregular in its monthly return; or as to the quantity of fluid lost at each period; it may arise too early in life, or continue too late. The first consideration is, where it arises too early in life; perhaps, however, there is no such thing as menstruation beginning too early in life, except as connected with a complaint. It may arise from too great strength of constitution and vascular action; from increased fullness of vessels, depending on too large a quantity of animal food, for the wear and tear of the constitution. There is a full face; a full pulse; throbbing in the head; the breasts are full, with a warm imagination. This secretion arises properly at sixteen; but here it begins at twelve or thirteen. As in this case it arises from too much blood, we should take some away; prescribe purges and strong exercise; but the medicine must be chosen. Rhubarb, jalap, senna, colocynth, and aloes, are not calculated to diminish the quantity of blood; they only increase the peristaltic motion of the intestines. Saline purgatives should be preferred, and a spare diet must be insisted upon.

The other state of the menses is, where they stay too late; this is more common than the preceding affection, and more especially in large towns. It occurs where there is too little blood, and the uterus is not in a state fit for conception. The pulse is weak, the appetite disordered, the countenance pale, the constitution below par in point of strength. We will now consider both the states just described. The first will be liable to sudden inflammation of the lungs, and has that state of body which predisposes to what is called a galloping consumption. The other will generally be more or less a scrophulous habit, disposed to go into a decline, or slow consumption. Here the mode of treatment adopted in chlorosis may be superadded to that for the restoring health by sea-bathing, if the lungs be not any way affected, and the stomach in good order, but not where there is a weak stomach or oppressed respiration.

Of Amenorrhœa or obstructed Menstruation. Of this there are two kinds; one the acute, or accidental; the other the chronic. The acute,

or accidental, arises where there is perfect health up to the time of menstruating, and the patient takes cold at the point of discharge, or even while menstruating, and the flow is prevented or suddenly ceases.

Obstructed menstruation generally depends upon the application of cold; this will produce a fever which will stop it if coming on, and arrest its progress, where it has already commenced. In all such cases there is pain in the head, back, and loins, pain in the limbs, with all the symptoms marking fever. If we know of this early, we may with ease give relief. We may always take away blood, and clear the bowels; rhubarb is the best medicine; then a saline draught, with antimonials in such quantity as to come short of vomiting, and five or six drops of laudanum, or four or five grains of ipecacuanha every six hours. The warm bath is productive of advantage where applied soon after the complaint has begun. Where the slipper bath is not at hand, the lower part of the body may be seated in a volume of tepid water in a large tub, or the convenient vehicle called a hip bath; after which the patient must be made very dry, and put into a warm bed, and use the remedies before mentioned; and the discharge will return, or, if not immediately, it will ultimately return, and the health remain unimpaired: but, if the menstruating period be passed over, it then becomes a chronic obstruction, the symptoms attending which are very destructive of female health.

Of the chronic obstruction of menstruation there are also two kinds, which have each a distinct set of symptoms; those of plethora, and those of weakness; and chronic obstruction, depending on plethora, may degenerate into that kind depending on weakness. The patient will first be taken with symptoms which only belong to plethora, and after that arise those belonging to weakness. The young are most liable to the first kind, in whom the quantity of blood is much increased beyond what it should be, by luxurious habits, and where too little exercise is taken for the quantity of food; and even here it will not often lead to obstruction, unless the occasional cause is applied by taking cold: when this does really happen, the attack of fever may be so slight as not to be observed by the patient. Where we see all the signs of the system being loaded with blood, we should certainly take some away; where the pulse is hard, full, strong, and frequent; the skin dry and hot, more thirst than there should be, with pain in the head, back, and loins; where, especially, instead of an active disposition, we see a desire to be always by the fire, and the girl at the same time liable to giddiness. Here the pulse is nearly up to 10Q, which being an increase of more than twenty beats in every minute, the effects of such increased action is, that the strength will be worn out, and the chronic obstruction from plethora be changed into the chronic obstruction from weakness; the reason is this, that the action is so strong that it may, by continuing, exhaust the powers of life; nothing indeed exhausts the strength of the system so much as increased action of the heart and arteries; for it is not the pulsating arteries alone that are affected, but in the same proportion is the action of all the capillary vessels in the body increased, so that the whole extent of increased action is prodigious. It being known that the action arises from obstructed menstruation with plethora brings on weakness, it might be expected that the strength of action would be brought gradually down to the point of health; but that never happens; it sinks below it. This sort of obstructed menstruation must be treated by evacuation, by bleeding; but the foot is not preferable, as we do not get blood enough by opening the vena saphena, unless the foot be immersed in warm water; and if this be done, we are unable to tell the quantity we take, unless we from time to time measure the water. The best way, then, is to bleed from the arm, and with bleeding to use purgative medicines; the patient should take much exercise and little sleep, and, on the intermediate day to those on which we give the purgatives, we should give saline draughts. The effect of this will be, that she will be brought down from great and morbid action to the state of health; and it is fifty to one but the menstrual discharge returns immediately.

This species of chronic obstruction proceeds from plethora, and plethora may exist so as to prevent menstruation either at its earliest effort or after it has been long in the regular habit of recurring. The term chlorosis is generally applied to the first kind; amenorrhœa to the second; but chlorosis, or green-sickness, is a mere result, and may result from either; it is that chronic menstruation depending on symptoms of weakness we have already noticed, and may result from each as well as from a distinct and separate source, because the continued action of vessels exhausts the

strength. Usually, however, the complaint depends on improper food, living in bad air, or want of exercise, and, added to these, want of communication between the sexes; for a certain state of the ovaria predisposes to it. One symptom in this kind of obstructed menstruation is, there being a mark perceived round the ancle at night where the edge of the shoe reaches; another is, a fullness and puffiness of the face and eyelids in the morning; so that, after sleep, the whole countenance looks too big; while in the course of the day, this size and appearance goes entirely off. These last effects are evidently those of œdema, because during the day the water lodged in the cellular substance about the face subsides, and the cells below are progressively filled; so that by night the ancles are swelled: during the night again, the gravitation of the fluids diffuses the appearance of swelling over the face.

The upper extremities partake at last in this appearance, becoming swelled about the hands at night. In short, the whole skin is swoln and stretched, and assumes a soft pappy feel. To these symptoms there is now added a very great derangement of stomach, the appetite goes quite away; sometimes the patient has an inclination for improper food, a vehement fondness for cinders, candles, or pipe-clay; this does not seem to belong to any sort of instinctive impulse from nature, but depends on a derangement of stomach alone: all these evidences are further proved by flatulency and a sense of weight at the stomach after eating; great irregularity of the intestines, sometimes costive, and at others lax; vegetables undergoing their acid fermentation; and animal matter its putrefaction; both known by eructation, both dependant on the impaired state of the stomach: to these succeed difficult respiration, either on walking or going up stairs; and this does not arise from ordinary weakness where a person could rest, because she was tired; but in chlorosis she stops because she loses her breath: with this there is palpitation at the heart; the pulse is frequent, small, and hard; and there are hysterical symptoms, very often, where the obstruction has been of long continuance. This complaint, however, is easily cured where it has been of short duration, and the menstruation is not permanently interrupted.

The *treatment* will depend on the form which all the symptoms take on when combined. Though cases of this obstruction differ from ordinary weakness, yet the treatment we should pursue will be applicable to most cases of weakness. It is right to keep the bowels clear, by an occasional dose of rhubarb; we should then begin the use of bitter medicine, remembering that in proportion as the weakness is greater, the medicine should be weak; for it is an error to suppose that the stronger a medicine of this kind is, the more efficacious it must be. In all cases of weakness, we must consider the lightest bitters as the most proper; at first, a dram of the bitter tincture to an ounce and a half of peppermint water; or an ounce of the bitter infusion instead of the tincture. But at the same time we must recollect, that the stomach is still a weakened organ: the powers of digestion must be still weak, consequently digestion will not be so quick, nor will the food be pushed forward from the stomach so soon as it is in health; and the second meal will be ill digested, because the whole of the first has not left the stomach: for these reasons, a gentle purgative must be joined with the food. A good medicine is bitter pills, formed with such materials as will allow the stomach to act on them without much difficulty.

Of all medicines, bark is the worst here; it requires a good stomach to digest it; it increases every difficulty of breathing that may have existed previous to its use. Now and then a gentle emetic will be useful; we may for that purpose give five grains of ipecacuanha every half hour till it operates. After the bitters have impaired the tone of the stomach, this gentle action will restore its strength, and render them as efficacious as before: when the stomach is strong enough, we may begin with steel, the best form of which is called Griffiths's draughts, but it is the most nauseous mixture that ever was made as originally prescribed; and we should therefore prefer some one of the numerous modes in which this medicine has of late years been revised. By these means the weak patient will be raised up to that state which is nearest health; while the plethoric patient is lowered down to the same point. These two patients being now brought to that same point which is most favourable to menstruation, it remains to discover the best means of getting back the secretion. Having brought down the plethoric, and raised the low and weak patient, so that both are on a par, we may now begin with the emmenagogue remedies.

All medicines called emmenagogues are stimulating; we must never use strong stimuli where the constitution is yet weak, or we shall only exhaust the system, and where there is a tendency to plethora, we shall produce hœmoptoe: these then must not be begun upon till the constitution is amended. Some employ hellebore, which has sometimes certainly evinced great power, for which reason we may give forty drops of the tincture, though most commonly the menses will return without giving any thing. Madder is recommended from its supposed deobstruent quality. Instances of its wonderful powers are related in Dr. Homes's practice. Now and then electricity has been useful, when the patient all but menstruates. Friction of the lower extremities is good as exercise. Issues have been recommended; dancing, air, and exercise, are the real, the natural, and only effectual remedies. It is merely necessary to determine to the part; we well know that a mother directly as she takes the child in her arms, feels the draught of the milk come into her breast, even before the child is put to it.

Profuse Menstruation. We now proceed to consider the opposite state to obstructed menstruation, which is profuse menstruation, or *menorrhagia*; this is where it returns too often, though there may not be too much lost in each time; or, it may be, there is twice the quantity lost at the regular time: in short, in whatever manner the secretion is increased, so as to weaken the constitution, it is called menorrhagia. Whether there be too much or too little tone in the vessels, they may be inactive; allowing their contents to escape as they do in petechial fever, both into the cellular membrane and into the urine.

Profuse menstruation may depend on increased action of the heart and arteries; or on too much food, drink, or stimuli in any shape. And the symptoms which appear in the constitution from such causes, will be just those of plethora: stuffing of the chest, heat and thirst, concurring with this profuse menstruation: and the same treatment of the constitution will remove it: this is the simplest sort of menorrhagia, and requires least discussion. We must prohibit the use of animal food, and keep the bowels in a state of purging with Epsom salts. What we want is not a violent purging, but a gentle increased action of the bowels; by this we pall the appetite, which is another object gained; and it does not allow the food to remain so long in the stomach, while part of the circulating fluids is evacuated by the increased secretion we have produced into the intestines. If this treatment be not sufficient, it will be necessary to apply those local remedies prescribed in floodings.

The next state of increased menstruation is, from relaxation of the system. This will sometimes arise from increased action, which we have said will occasionally degenerate into a weakened state; for the effect of great action is the production of great weakness. Where there is a weak pulse, flabbiness of the muscles, and all the symptoms of weakness and relaxation of vessels, a very small force of action in the heart will be equal to the forcing of blood through an open vessel. All the strengthening medicines as well as astringents will be necessary here; alum and bitters: and where there is nothing of a vibrating feel in the pulse, steel may be given. But, sometimes, when the profuse discharge depends on relaxation of vessels, steel will increase the discharge; yet, where there is no fever, it is one of the best remedies. Next come the cold bath, and moderate exercise in a pure air. In regard to steel, it must be given very gradually at first, as in the mineral waters which are so famous. The stomach will frequently not bear it less diluted. It is very beneficial to recommend patients to some mineral spring in the country, even from a secondary desire to get them out of town, where they may rise early, and enjoy the benefit of a country air. The patient goes with hope and expectation of relief; her mind is amused, and her health repaired by drinking the water, though in the water there should be no virtue at all.

The next sort of menorrhagia does not depend on general, but local weakness; arising from the woman having borne a great number of children, and the weakened state of the uterus. This effect is sometimes dependant on excessive venery; hence we account for the violent attacks of menorrhagia prostitutes are very subject to. It may arise from blows on the abdomen. This is a more unmanageable case than the others; because the weakness is local, and any strengthening remedies applied, constitutionally increase the strength of both parts at the same time; so that there still is the same difference between the system and the uterus in point of tone, because they are both equally raised; injecting cold

and astringent solutions into the vagina as the best remedy. Though now and then a case occurs, in which the opposite means succeed, where every cold application has failed, and throwing up tepid water has put a stop to it.

The worst state of relaxed uterine system is, a great local weakness of the uterine vessels, which cannot be acted upon through the medium of the constitution. Since the hemorrhage will be increased by whatever increases the strength of action in the heart and arteries, it would be more an object to lower the constitution; and the best measure is, to leave it altogether, only attempting to stop the hemorrhage by local means. But the cold application, so often recommended, will fail; a piece of ice has been in the vagina a whole day without stopping it. In these cases, the most likely thing to succeed is, to introduce an injection into the uterus itself; to do which, a tube must be carefully passed up into the uterus, like a male catheter. We must withdraw the wire from the tube, and insert the nose of a small syringe into the tube, and press forward a little of some astringent injection; as soon as it produces pain in the back, the pipe must be taken away, because a very little of the solution will be enough; if there be thirty drops in the uterus, it is quite sufficient. In the very worst case that has been known to happen, this method was completely effectual in the cure.

Painful Menstruation. Dysmenorrhœa, or painful menstruation, is a complaint in a state of nature unknown; but it happens among those who do not marry at the time of life nature intended; for which there are many reasons in the present day, and among the rest the difficulty of maintaining a large family; consequently women are thrown out of a state of nature, not doing that which nature intended. The patient when first attacked with this disease, feels hardly any pain, or if she feel pain, it is only very slight in the lower part of the back, which is from the consent of certain nerves with the uterus; but in four or five years it becomes established pain in the back, as violent as grinding pains in labour. Such a woman will afterwards bear labour very well, and declare that she would rather bear a child, than experience the pain of difficult menstruation once a month. In this manner the pain increases, but the menstruation goes on very imperfectly for some time; and when at length it becomes more plentiful in quantity, the pain lessens, and the last two days of the secretion is not attended with any pain.

The appearance of the fluid in this disease is not that of menstruation, as it usually occurs. There are coagula of various sizes, and if what is discharged be examined carefully, flakes of coagulable lymph will be perceived. This state arises from interruption of the functions of the uterus, and it is a situation in which the uterus is much less liable to become impregnated; but if it do, the patient may go on to menstruate without any pain to the end of her life, or perhaps, with less than she suffered before. This complaint is more frequent in large towns than in the country.

The first object in regard to treatment is to remove the inflammation, for there can be no difficulty in supposing inflammation present at the time the pain is so violent: one strong proof of which is, the coagulable lymph being thrown out. The patient for this purpose should leave off animal food entirely, if possible, at least partially; should avoid all liquors, live as simply as she can, and keep the bowels in such a state, that the stools may not be hard. If she be strong and plethoric we may bleed once; but it is a bad principle to bleed young people, as it lays the foundation for a larger quantity of blood being formed than ought to be. Between one period and another, the parts about the pelvis should occasionally be immersed in the tepid bath, and afterwards rubbed, and as soon as the pain comes on should be put in a warm bath: this may even be done the night before. The pulvis Doveri should also be given to assist perspiration, which is always an object in the present case. Pursuing this plan, the habit will be broken, and the patient may go for years without menstruating with pain; but when it returns, the same ground must be gone over again. It is often entirely relieved by marriage; so that it may sometimes be useful to recommend this change of state to the consideration of the parents.

Fluor albus—Whites. This is another and very common complaint. Most women conclude it leads to disease, and some are much alarmed at its appearance. In procidentia uteri, it arises mechanically; for its cure, which is sometimes very tedious, the cold water bath is the best remedy of any that we know of: cold water may be injected into the vagina, and if this be not sufficient, an astringent may be added. The case is most unmanageable, when aris-

ing at the cessation of the menses: here it often precedes disease of the uterus, and should be treated as if we were in expectation of schirrus; recommending a careful abstinence from wine and spirits; animal food to be quite cut off, if the constitution will bear it; together with which, no exercise of any consequence should be allowed. An occasional purge should also be given; the injection and bath being used regularly.

Procidentia uteri, or the falling down of the uterus. The uterus is connected laterally to the pelvis, by the broad ligaments; and anteriorly by the round ligaments. When these parts have lost their tone, they allow the uterus to fall through the vagina, so that the menstrual discharge has been frequently seen coming from the lowest part of the tumour, the os uteri. The most frequent causes are, rising too soon after delivery or after abortion. Next to fluor albus, it is the most common female complaint that is met with. There is a dragging feel in the back, and uneasiness about the hips, arising from the dragging at the broad ligaments: there is also a pain in the groin, and the tedium these sensations produce are exceedingly uncomfortable, though not amounting to pain. The procident uterus will at last interfere with the stools and urine, and be pushed down at those times, when the woman tells us she feels something like an egg; this gradually increases till at last it falls altogether out of the body, producing pain, and perhaps ulceration of the os uteri, from the contact of the clothes; and the bladder, from its connection with the uterus, being dragged down, makes an angle with itself, which stops the passage through the urethra. Now while there are these powers acting in bringing it down, there are no muscles to bring it back; and where gravitation leaves it, there disease finds it. The only sure relief for procidentia uteri is from the use of pessaries; the best are of an oval form, flatted on both sides; the outer edge must be left broad and rounded off, as it is in close contact with the soft parts round it; but towards the hole in the middle it may be made thinner, and this will diminish the bulk and weight: these are to be kept of different sizes. The best are of wood; the cork pessaries cannot be kept clean. They were formerly made round; but this is more convenient, and obstructs the passage of the urine and faeces; they also used to be made with very large holes, this was dangerous; the os uteri has become strangulated by getting into it; when this has happened, a pair of pliars may be so introduced, as to break down the ring, so as to enable us to get it out. In introducing this instrument, it is anointed as we please, and so passed edgewise; it is to be laid across the pelvis in such a manner that the largest diameter is from one ischium to that on the opposite side. This disease is curable in early life by a horizontal posture, and the use of astringent solutions.

Dropsy of the Ovarium is by no means an uncommon disease; its first symptom is a sense of pressure on the bladder or rectum; it may further affect the nerves and absorbents, producing dependent symptoms. But it is so long before it produces any real illness, that the water has sometimes been drawn off for some mouths before any other complaints have been felt. From one tumour, forty-nine pints have been drawn off; and in a few days afterwards, from another tumour in the same patient, nine pints more. There is a case mentioned by Bonetus, where one hundred and twelve pints were drawn off. The fluid in these cases is not serous, but gelatinous and glary; and there has been fat and hair found in these tumours, and even teeth; this will happen where there has been no impregnation. It is a disease which may be borne a long time: in one patient, who had it from the year 1770 till 1798, it was tapped as often as eighty-four times. In the memoirs of the Royal Academy, a woman is mentioned who had it from the age of thirty to that of eighty. It always begins on one side, and gradually spreads over the other. As to treatment, none in the way of medicine has been known to have the least effect upon it. Tapping will not always be quite successful; therefore, the patient should be warned of the probability of there being more cysts than one.

Another complaint to which females are subject, has been called *Dropsy of the Uterus*; but, for many reasons, no such disease can exist, and the expression therefore is incorrect. The cases mentioned of this disease have most probably been hydatids in the uterus. It is, however, a slight complaint which cures itself. Dr. Clarke mentions a case, where a lady with a tumour of this kind went into a pastry cook's shop, and sat down in the parlour; the wet, which she felt, increased, till the whole shop was deluged, and very unpleasant conjectures were the consequence. In another case,

a lady was riding in a coach, and driving over the bad pavement, in consequence of which the weak membrane gave way, and the whole fluid escaped. Instead of a single hydatid, there may be some thousands hanging in clusters of all sizes. There will be no symptoms but increase of size, with occasional discharges of water; and, when the uterus does contract, nothing will come away but the water and hydatids.

There are several other diseases which appertain to these organs, but which belong rather to the department of surgery than of the obstetric branch, and to that department we shall transfer them. These are enlarged nymphæ, imperforate hymen, diseased labiæ, polypous tumours, schirrous and cancerous uterus.

Final Cessation of the Menses. This is a work of time; a work which proceeds slowly, for nature never acts abruptly. The discharge is first broken after having continued from fifteen to fifty years of age. It is necessary, indeed, that it should be stopped gradually, to prevent the constitution from being destroyed; and it happens that the body is frequently broken by this event; in fact it is one of the most dangerous periods of a woman's life. It not uncommonly happens that the menses at this time become profuse, producing dropsy, and the woman is carried off in this manner. Another evil is, that at this period all glandular complaints which may have lain dormant for many years, now come forward. A little lump in the breast which has hardly been felt for years, will now be converted into a formidable cancer, which will destroy if not removed. Not unfrequently a tumour, which has long lain harmlessly on the os uteri, will now begin to give pain, enlarge, and be troublesome. The utmost care is necessary in regard to simplicity of diet, and regularity of exercise and rest; and the state of the bowels should be carefully watched.

At this period, also, there is a disposition to a general enlargement of several of the sexual organs, which often induce a woman to suppose that instead of finally ceasing to menstruate, she has once more begun to conceive. The uterus appears to swell, the breasts to become full, and there is a sense of motion in the uterus as though a fœtus were in the act of struggling. This affection, for want of a better name, is generally called spurious pregnancy. Perhaps we are not exactly acquainted with the cause, but we know what is of far more consequence, and that is, that in point of fact, there is no pregnancy whatever, and that the symptoms which thus mimic it, subside in a few weeks, when attacked by a course of gentle cathartics, and free exercise.

CONCEPTION.

It is usual in this part of a treatise on midwifery, to examine the different theories which have been offered to the world on the mysterious subject of conception. The general physiologist, however, has usually contended that such an inquiry is a branch of his department, and upon the whole we believe the physiologist to be right. On this account we shall transfer whatever is usually offered upon conception, to the article PHYSIOLOGY, under which the reader will find an account of the whole at present known upon this subject.

We have also given a distinct section under the article FœTUS; to which, therefore, we refer for a minute account of the fœtus itself, and the contents of the gravid uterus in general, in regard to their structure and anatomy.

PREGNANCY.

Pregnancy produces a great number of changes in the constitution, dependent upon the change which takes place in the uterus, the great centre of sympathy in the female frame. It also produces a variety of complaints which are rather troublesome than severe, and many of which must rather be palliated, than can hope to be cured till the abdomen is relieved of its weight. These are sickness, vomiting, heart-burn, costiveness, or diarrhœa, suppression of urine, and its consequences, and especially retroverted uterus, from a full bladder pressing upon it before it is much enlarged, varicose veins. Pregnancy is also not unfrequently succeeded by abortion or miscarriage. As we proceed we shall have occasion to refer to a few of these; the rest must be relieved by palliations and remedies employed as occasion may demand.

Among the earliest proofs of pregnancy, or of conception, as it is first called, we may mention a disposition to hysteric fits, and, especially in delicate habits, a continual tendency to fever; the pulse increased; the palms flushed; and even sometimes a small degree of emaciation; an alteration in the constituent principles of the blood also

generally arises, giving a buffy appearance to the blood; and if from any complaint fever ensue, this buff will be greater in quantity than at any other time it would have been; the face will grow thinner, the fat being gradually absorbed. There are also other symptoms of hectic; but the changes in the countenance are most observable. The little fever sometimes occasions a great churlishness of temper; a woman in such circumstances can hardly bear speaking to, and it frequently creates a degree of fretfulness unknown before.

Another sign of pregnancy is, pain and tumefaction in the breast, which is only a part of the uterine system, and is affected from the same cause with the uterus. The areola becomes darker and broader than before; the rete mucosum is sometimes so altered, that it is as dark as that of a mulatto, while the skin generally is as fair as alabaster. The breasts enlarge, and will not bear the pressure of clothes so well as before; the woman will not be able to lie on one side so well as before: this proceeds from the skin not increasing in proportion to the secretion of the glands.

The next part that sympathizes with the uterus is the stomach; this is generally perceived in the morning; for though occasionally it is affected the whole day, it is generally felt on first being erect in the morning. The morning sickness in the progress of pregnancy is closely connected with the growth of the child; so much so, that it has sometimes been a rule to judge that where this ceases the child is dead. Pregnant women have antipathies and longings, and this desire is in some for the most strange things, as is well known to almost every medical practitioner. No woman can be with child if she menstruate; this is the *sine qua non* of pregnancy; for though there may be sometimes an appearance of blood, there is not that regular appearance of uncoagulating fluid which constitutes the menses; even in Hippocrates we may see this. If in a young woman, between the age of fifteen and thirty-two, the breasts shoot and are very painful, and she be not regular; if the areolæ be enlarged and dark, and she have morning sickness, there is little doubt but that she is with child. It is not likely that all these things should by any accidental cause be present at the same time, though any of them may arise. There are also peculiar symptoms attending the pregnancy of particular women, as a cough, tooth-ach, head-ach. Dr. Clarke relates an instance of a person being as completely salivated during a certain period of her pregnancy, as ever was a patient in the Lock Hospital. When these symptoms occur, they mark a peculiar idiosyncracy in the constitution, and are the surest possible indications.

The uterus being the great centre of sympathy, the diseases of pregnancy are so many sympathies; and, considered as such, there are no parts which may not become affected by its influence. Not uncommonly there is a continual state of low fever; and yet pregnancy prevents the coming on of many diseases; but though it prevents many, it produces some which are serious.

The most troublesome complaint to which a pregnant woman can be subject, is a retroverted uterus. When this disease was first known, it was supposed to arise from fright, or some other surprise; but this is not true. There are no muscles attached to the uterus, nor is it capable of being influenced by muscular action. The only true cause for this change of position in it, is quite mechanical. There is frequently great fulness of the bladder, and if it be very much distended, the retroversion will happen in consequence. The only period in which it can happen, however, lasts but four weeks, between the end of the third month, and the end of the fourth. For in the early months of pregnancy, the uterus, in length from the fundus to the cervix, is not so great as to fill the space between the sacrum and the neck of the bladder, and cannot for that reason produce suppression, which alone constitutes the disease. This applies to all situations of the uterus in unimpregnated women, and women who are with child till the close of the fourth month of pregnancy; after which the uterus cannot be made to go down into the pelvis. When the uterus has once fairly mounted into the abdomen, it is impossible for it to pass down into the pelvis again.

The retroversio uteri occurs thus: the bladder becomes full and rises into the cavity of the abdomen; the neck of the bladder in rising draws up the os uteri with it, which drawing up of the os uteri is assisted by the fundus of the bladder pressing down that of the uterus, and, in nineteen cases out of twenty, the bladder in this way becomes the occasional cause of complaint; and when the complaint is formed, the suppression of urine is the only material object to be attended to. For the uterus

being retroverted the woman cannot make water; therefore, it must be drawn off by the catheter.

When the water has been once drawn off, it will be necessary to pass the catheter twice a day, till, by the enlarging of the uterus, it rights itself. As it increases in size it will gradually rise, but as it may not be convenient for a medical practitioner to call twice a day for some weeks, it is sometimes advisable to attempt the reducing it; which is done by the patient placing herself on her hands and knees, when the two fingers of one hand should be passed into the vagina, and a finger of the other into the rectum, by which means it is sometimes possible to succeed. Where the event is left to time, the uterus is sure to recover its proper situation; for which reason it is preferable to leave it.

In attempting to reduce a retroversio uteri, we must recollect always to empty the bladder, and never use force.

Abortion—Miscarriage. At any time after impregnation, abortion may take place: it is one of the most common complaints of pregnancy, whence it is matter of no small consequence that every practitioner should well understand it.

Abortion is not peculiar to the human species, but they are more subject to it than other animals, because they lead more unnatural lives. We see, agreeably to this rule, that the domestic animals more frequently abort than those that are wild. In the human species the greatest number of miscarriages are between the eighth and twelfth week; perhaps there are more at the tenth week than at any other time of pregnancy; but why this should happen at that time more frequently than any other we are ignorant.

There are two kinds of constitutions very liable to miscarriage; the most strong and the most weak. The most strong, because there are some causes which act upon the vascular system: the most weak, because many causes act through an irritability of the nervous system. There are also various occasional causes of abortion, and among these we may mention sympathy. This has such an effect with other animals, that there is not a shepherd but knows that if one sheep abort, others will almost always abort too. If a sheep lamb, the shepherd always separates that animal from the flock to prevent the other ewes lambing before their time. One animal is thrown into action, because the other animal is acting. Consents, also, are common in animals as well as sympathies. Certain parts of the body are connected in disease; the nose with the rectum in ascarides, and the shoulder with the liver; crying is known to produce tears in many beholders. These are so many instances of a fact, which proves the impropriety of a pregnant woman being ever in the room with one who has been lately miscarrying. Yet perhaps the true cause of abortion is an indisposition in the uterus to grow after it has reached a certain size; when arrived at that size contractions begin, labour pains succeed, and this, being accompanied with the expulsion of the ovum, constitutes miscarriage; whether this happen at the second, third, fourth, or fifth month, it is still abortion.

The uterus is in some degree of the same nature with the bladder. In different people we know the bladder, without inconvenience, contains a different quantity of urine; in one person it will not, without his feeling uncomfortable, contain more than six ounces; but that is not as much as it can hold, because it will, if necessity urges, contain four times that quantity. In proof, that it can dilate, every person may have observed that at one time the quantity which he retains with convenience will vary from that which he retains at another time. It is the same with the uterus, which may be disposed to hold a certain quantity of contents only, by which the ovum attains not more than a certain size before it excites the involuntary action of the uterus by which the whole is expelled. That the disposition exists, and that this often produces miscarriage, appears hence, that many women go to the usual time of miscarriage, and feel all the signs of disposition to abort, and yet, if they keep quiet for a sufficient length of time, they will recover, and go the full time of pregnancy. This is accounted for by the disposition in the uterus to contract at a certain period of gestation. Tumours also may cause a disposition to miscarriage; constipation acts in the same way, for, while it lasts, it produces exactly the same effect that other tumours would. All circumstances which, by increasing the circulation, keep up too great a velocity in the motion of the blood. Thus, violent exercise will produce miscarriage; it will, by the increased motions of the blood, separate a portion of the placenta from the uterus, which is very easy to conceive; for a certain force, being applied to the cells of

the maternal part of the placenta, will be sufficient to rupture them: and the cells giving way, the blood will make its escape between the surface of the placenta and membranes, so as to form hæmorrhage. Where the flow of blood from the ruptured part is considerable, and it finds a different course between the membranes leading to the os uteri, it will produce then a considerable degree of hæmorrhage. Violent hæmorrhage will also sometimes arise from the use of spirits in two large proportion. Now and then accidental injuries done to other parts of the body will cause a partial separation of the placenta from the uterus. Acute diseases of the mother; pleurisy, acute rheumatism, continued fever, small-pox, scarlatina, may any of them produce miscarriage: there is no disease in which abortion is so dangerous as in the small-pox. Passions of the mind will frequently cause it; and none so surely as those which increase the action of the heart and arteries. Rage may separate the placenta from the uterus very soon. It is not essentially necessary that the force of action of the heart and arteries in general should be increased, because increased local action of the part is quite sufficient; whence the union of the sexes often causes women to abort; and, to make sure of breaking the habit, the best way is, to separate the wife from her husband for a time. Violent exercise of almost any of the passions may produce the same effect.

With regard to the signs of approaching abortion, the first and most obvious change is the absence of the morning sickness, which sickness is always a sign of health in the fœtus, and goes away when the fœtus dies. Another symptom preceding a miscarriage is, a subsidence of the swelling of the breasts, from being hard they become flaccid: by these signs will any woman, but particularly if she have miscarried before, know the approach of this state. There are also pains about the abdomen and back, which are so many evidences that the uterus has taken on this action. Hæmorrhage, in general, also attends these symptoms, though sometimes a miscarriage may happen with very little loss of blood. Women miscarry in various ways, with regard to the progress of the abortion. In some, the ovum is expelled, and in others it will come away in pieces. The ovum and its membranes may be thrown off first, while the decidua does not appear till afterwards: sometimes the ovum will come away in a clot of blood, and it would not be known as an ovum, if the clot were not broken down and examined: at times the membranes will break very early, and the fœtus will come first. In some abortions there is great pain: the grinding pains will sometimes equal those of labour: while in others there is very little, the ovum appearing to drop off from its connection with the uterus, upon the os uteri being relaxed, just as premature fruit drops from a tree; sometimes the loss of blood is great, at others little.

As to the prognosis in miscarriage, it will be influenced by the state of the constitution: if it depend upon the contraction of the uterus alone, the pains will go on as in labour, till the whole ovum is expelled. But where the miscarriage depends on some cause acting on the circulation, the woman will often lose a large quantity of blood, become cold, faint, and the blood will stop. If during her fainting she be revived by wine and warmth, the hæmorrhage will return, and the abortion perhaps be confirmed; but if these stimuli be avoided the blood will often coagulate, close the breach of continuity in the placenta, and the woman will go her full time of pregnancy.

There is very little danger in abortion, generally speaking, when happening in the five first months. We may say, that, provided the constitution be good, there is no danger before the fourth month. The vessels at this time are small, and the hæmorrhage is seldom rapid, and the safety or danger of the patient will depend upon the proportional size of the vessels from which the blood issues, together with the time in which it is lost. But if it be continual, though not from large vessels, it may at length kill either immediately, or by overpowering the constitution. A child may be bled to death by leeches, and an infant has been known to die under the operation of a single leech; a woman who does not die while the blood is flowing, may die in consequence of dropsy caused by the loss of blood. Abortion never ends at once in death, but it produces weakness and dropsy. All miscarriages are more dangerous while the woman has an acute disease, and most so with the small-pox; the most dangerous days being from the eleventh to the thirteenth day of the eruption. When hæmorrhage happens before abortion, it does not follow that the ovum must be destroyed: [illegible] the placenta

may still remain attached to the uterus to carry on all the purposes of life, and the pregnancy will go on. The constitution, if good, will generally bear the loss of a little blood; as much should be taken as the patient can bear, for twelve ounces at once will be more effectual than sixteen ounces at twice in restoring the balance in the system. After which a saline draught may be given every six hours, with about six drops of laudanum in each; it is rarely useful or necessary to press the opiates beyond that quantity; a large dose of opium will frequently increase the force of action in the heart and arteries, while a small one will keep it in the state desired. The bowels must be kept lax with small doses of the purgative neutral salts; the patient must at the same time be kept quiet, with little or no animal food; farinaceous decoctions, with vegetable nutriment, are all that should be taken while this state remains, as these do not add to the force of the circulation.

If the abortion, instead of arising from these causes, and being attended with these symptoms, proceed from passions of the mind, or a relaxed state of the os uteri, the plan to be adopted is the use of opium, and the quantity must be considerable: if it be small it will do nothing; but if large, the pains in the back and uterus will be relieved, and the abortion quite put by. When a habit of miscarrying is acquired, the woman will know the period at which it is likely to occur, and, before that time come on, laudanum should be had recourse to, from ten to fifteen drops, increasing it gradually till the time of danger is passed over.

The next occurrence demanding attention is the hæmorrhage: we see clearly that fainting is nature's method of restraining a flow of blood. In faintness we know the small vessels are constricted by the whiteness of the skin; we also know that cold is remarkably effectual in stopping a flow of blood from any part, but especially the uterus: not only cold air, but cold water, and even ice, to the back, belly, and parts themselves; every thing should be taken cold, and congealed if possible; ice creams, juices of fruit, seeds, &c.; all the body should be cold, both externally and internally. Considerable benefit is derived from ice being introduced into the vagina, and replaced every two or three hours; this will restrain uterine hæmorrhage more frequently than any thing else; and if it do not stop it, the constitution will still be secured from the effects which a more profuse hæmorrhage would have incurred, and the patient be preserved from the excessive weakness which would have been the consequence of it. Where there is pain without hæmorrhage, there is no necessity for being very anxious; for in that sort of abortion the pains will gradually increase as in labour, and the ovum will be thrown off; after which the pains will gradually go off again, and abortion must take place here before the pains can subside. But it sometimes happens that there is great pain with the loss of blood; and though it may be that nothing good can be done to restrain the hæmorrhage directly, yet assistance may be given in emptying the uterus; for after the ovum has separated, sometimes it will not come away; in this case the finger of either hand may be introduced and some part got away; and if this should not be practicable, it is sometimes possible to get in two fingers, and by this contrivance pass them through the os uteri, and restrain the hæmorrhage by compression.

Should the ovum not be capable of being brought away whole, the membranes should never be broken, unless when after the fifth month, the child can be felt through them before tearing them, in which case it will be possible to get hold of part of the fœtus, and so get it through and relieve the woman from danger; for though in the early months abortion is not dangerous, the danger increases every day, and when it admits of being treated like premature labour, it always should be, as that treatment ensures absolute safety to the woman: but if the membranes be ruptured in any early abortion, or before twelve weeks, the odds are, that there will be no more pains, for the waters having escaped which formed the bulk of the ovum, nothing but the thin skins remain behind, and these are so small, that they will not stimulate the uterus to act, and yet the vessels will continue to bleed.

Abortion is prevented, in the first place, if by observation and knowledge of the patient's life, and knowing her to have been subject to miscarriages, we may induce her to avoid the same cause which has before produced it. It will next be necessary to take care that this does not occur, even if the former cause is applied, by bleeding and opening the bowels, where there is sudden occasion, otherwise by laxatives and occasional bleeding only. If, on the contrary, there is reason to believe that the

woman miscarried from weakness, we may prevent a recurrence of it by strengthening her by good diet, and the use of bitters and tonics. There are women who appear to miscarry regularly from the state of the uterus being, as we have already observed, unfavourable to growth beyond a certain extent; in this state abortion is frequently prevented by immersion in the warm bath; it lessens the disposition of the uterus to contract. If there be any reason to suspect great weakness in the uterus and uterine vessels, the application of cold will be of great advantage in giving the proper tone to the vessels. Many women miscarry in consequence of the connection between the sexes: when this cause exists, the parties should be separated till the period is gone by; for after quickening there is infinitely less risk of its occurrence.

LABOUR.

The gestation being completed, labour, or the pains so denominated, is the natural process by which the child is forced into the world.

There is some little variance in the term of gestation of different women; at least the regularity in the human species does not equal that which we behold in other animals. The usual term is forty weeks, or nine calendar months; and the period from which the time ought to be dated, is a middle point between the antecedent and succeeding times of menstruation. The Roman law allows ten months to legitimate parturition, or, in other words, ten months after the death of the husband. Hippocrates, upon whose opinion this law was probably founded, allowed this term, in like manner, as its utmost stretch, and would not extend it a moment beyond. The old French law (for the present may perhaps vary) was coextensive. Yet Haller gives instances, which it is difficult not to credit, of eleven, twelve, and even more than twelve months; whence the law of England is wisely silent upon the subject, and chooses rather to trust to the fair professional opinion and observation of the day, in connection with collateral circumstances, than rashly and abruptly to ruin a female reputation upon a moot and controverted point.

It is a law of nature that about this period of time the fœtus should be expelled from the womb, and hence, whether living or dead, whether light or bulky, whether the uterus be strong or feeble, the fœtus is expelled. A thousand causes have been assigned for expulsion at this rather than at any other period, but not one of them appears to hold. It is a law of nature, and we know nothing beyond.

Labour then is intended to expel the child and its membranes from the uterus; and from the variety of phænomena it presents, it has usually, and may conveniently be divided into three classes: *natural*, *difficult*, and *preternatural*.

In the first kind the head presents, and the pains progressively increase, and in consequence of such increase, by pressing the head against the orifice of the uterus, gradually enlarge it, by which it becomes protruded into the vagina: the same coercive power being exercised over which the head of the child is shortly afterwards protruded into the world. The whole process is completed within twenty-four hours at the utmost, and is unaccompanied with difficulty or danger.

In the class of *difficult labours*, the head indeed still presents; but the term is protracted beyond this period from accidental circumstances, that render it doubtful whether the life of both the mother and child can be preserved; or are else accompanied with other accidents, as twin cases, floodings, convulsions, rupture of the uterus.

The class of *preternatural labours* includes every presentation besides that of the head, or that of the head itself in conjunction with an upper or lower extremity.

NATURAL LABOUR.

In this division of labour there are four stages, according to the mode in which its progress is usually contemplated. The first stage is that in which the head of the child enters the pelvis, passing down as far as it can move without changing its position. The second includes the period of the child's head passing through the cavity of the vagina and os externum. The third, the change taken place in the vagina and os externum. The fourth, the delivery of the body of the child, and the expulsion of the placenta. In one of the two first stages the os uteri dilates, and in one of the three first the membranes are ruptured.

In the regular process of natural labour, the head, by the contractions of the uterus, is forced down and passed through the os externum. The uterus, after an interval of rest, again contracts, by which effort the shoulders are expelled. The breech and lower extremities presently follow. Dur-

ing the progress of expulsion the uterus contracts around the remaining parts of the child, and at the time the placenta only remains, the uterus is only sufficiently large to contain it. The next effort of the uterus, therefore, by contracting its internal surface, not only assists in pressing out the placenta, but becomes the cause of the separation; while the same power, which separates the placenta and throws it off, prevents the occurrence of any serious hæmorrhage. This is a most beautiful illustration of the mercy and power, as well as wisdom of the Almighty.

At the commencement of this process there is almost always a discharge of mucus tinged with blood, from the vagina, and the blood is sometimes intermixed in considerable quantity, a fact, however, which is of no consequence. There is at this time also, very generally an uneasy oppression about the præcordia; and as the pains increase in violence, vomiting will often arise from the extreme distention of the os uteri, while the pulse generally augments in strength and frequency. At the same time the progressive pressure of the child's head, expels almost involuntarily both the urine and fœces; while from the vicinity of the sciatic nerve, cramp, and paralysis, occasionally take place from the same cause.

In labours of every kind there are many things to be attended to, which, though seemingly frivolous, are yet of great importance, and, in general, are only manageable by practice: first, then, the bed should be so made, that the woman may lay comfortably both in labour and after labour, and that she may lay in the best way with regard to our convenience. If she be used to a mattress she may lie on one, it being the best sort of bed; but if she be afraid of a mattress, she may be allowed to lay on a feather bed, first making it as nearly as possible a mattress by beating the feathers all away to the other side of the bed. Upon the feather bed a blanket should be laid and a sheet, and upon these a common red sheep skin, or instead of it a piece of oil-skin or oil-cloth; over this a blanket doubled to four thicknesses; and lastly, a sheet upon this four times doubled, only lengthwise: this last sheet is to be laid across, and secured to the bedstead by tapes. When the os uteri is so far dilated, that in the event of the membranes breaking it would receive the apex of the head, the patient should be put to bed, but not before: for, with some women who have had children, it is astonishing how fast the os uteri will dilate itself; it sometimes takes place with such prodigious rapidity, that there is only time to get the woman on the bed before the child is born.

The woman should be undressed before getting into bed; her shift had better be tucked up round her; and, instead of a shift below, a petticoat will do much better, as it saves the linen. When placed on the bed she must lay as near as possible to the edge, and in the posture before described. This is equally proper in the easiest and most difficult labours. The lying-in room should be as airy as possible; and upon this principle it is that the poor people in the country get about sooner after lying-in, than the same class of inhabitants of this metropolis: in the generality of cottages it is not necessary to be very anxious about this, there are few of them so air tight but that they will do without a ventilator. If food be proposed during labour, we should generally speak rather against than in favour of it; for if food be taken, it must be either digested or undigested, in either case it is productive of mischief; if digested it becomes the fuel of fever; if it remain undigested, the stomach and bowels are all the worse for it; the proper refreshment is tea with dry toast, as this will do no harm.

The urine should frequently be evacuated, and the perinæum supported with the practitioner's left hand as soon as the child's head rests upon it.

The reason why the perinæum needs this support, is simply this; a woman bears down with a force equal to three, one of which is voluntary; the natural structure of the perinæum has enabled it to support, without danger, the contraction of the uterus; it has therefore, of itself, a power superior to two, which is the force of uterine contraction; but, in consequence of the patient's voluntary efforts being added to the involuntary efforts of the uterus, a force equal to three is acting against a power equal to only two. By pressing against this part, we do not say the head shall not come out; we only say it shall not come through a hole which is too small to receive it. In supporting the perinæum, it may be done through the medium of a folded cloth, which is held in the hand upon the perinæum, and keeps the hand clean from occasional discharges of meconium or fæces, waters, &c. and the perineum should not be left unsupported till the shoulders are born; indeed laceration more frequently

happens while the shoulders are passing, than when the head is. The great art is, to give support close to the edge, against which the greatest force is acting, for the parts give way first at the edge. The perinæum is to be supported from the time that it is stretched by the pressure of the head, and we must take care that we apply sufficient force to counteract the voluntary efforts of the patient.

As soon as the child is born, breathes and cries, we should tie the navel string. To do this, about ten threads must be joined in the ligature; the first made about two inches from the body, and the second, the same distance from that again, or towards the placenta. The division is made between the two ligatures, the second being only intended to prevent the blood escaping from the divided cord, and staining the bed. The next step to the separation of the child is the placing dry clothes under the patient, and to the perinæum. Midwives apply them warm; this should only be done in winter, for warmth increases the discharge from the uterus. We should then lay the hand on the abdomen to ascertain whether there is another child in the uterus; being satisfied of that, we are to proceed to the extraction of the placenta.

The uterus contracts after the birth of the child, so as to contain only this substance; and its contractions being continued, the surface naturally must first loosen and then separate itself from that of the placenta; and the same contraction which separates, expels it. It is generally necessary to pass the fingers up upon the cord which is held in the other hand, and if we be able to feel the root of the placenta, the separation is complete, and we have only to get it gently out from the os uteri. If the root of the placenta cannot be felt, it is dangerous to pull the cord with any degree of force; it is still attached to the uterus, and may produce inversion of the womb. When, by gently drawing the cord, we have got the placenta and membranes down to the os externum, we should have a bason ready to slip it under the bed clothes; and in drawing the placenta out, the cleanest way to bring the membranes with it, is to turn it round, by which means, after a few turns, we separate them neatly; after which it will be convenient not only to lay under the patient the end of the folded sheet which hung over the bed side, but also to make some degree of pressure upon the abdomen by bandage; after which she may be entrusted to the care of the nurse.

DIFFICULT LABOUR.

Of difficult labour there are three species: First, those labours which, though protracted, are ultimately accomplished by the powers of nature unassisted by art. Secondly, those which, although requiring the assistance of art, yet are compatible with the life both of the mother and the child. Thirdly, those which, besides being accomplished by artificial means, require that either the life of the child must give way to save the parent, or that of the parent to preserve the child.

The first source of difficulty is *weakness*. We know that labour requires a certain quantity of force or power, therefore labour is more likely to be difficult in weak than in strong women. We have many proofs to the contrary; but, generally speaking, it is so.

Fatness is another predisposing cause of difficult labour: fatness offers resistance, and generally occurs in women of weak constitutions; so that here we have both resistance and want of power. All asthmatic and pulmonary complaints generally will cause difficult labour. We know that to assist the contractions of the uterus it is necessary to take and keep a full inspiration; and where the chest is not equal to the task imposed upon it, the labour will be more probably protracted.

Deformity of Body, attended with constitutional weakness, will generally produce difficulty in labour; it is most likely that in these cases the pelvis is not formed as it should be, partaking of the state in which most of the other bones are. If a woman be too young, the pelvis will not be perfectly formed; and if too old, the parts will be rigid. The best time for a woman to commence child bearing is between the ages of eighteen and twenty-five. For though a woman may be in perfect health at thirty-six, yet we know that the parts were designed to be used at eighteen; and have been inactive for the rest of the time, and cannot then be so fit to act.

The next kind of difficulty in regard to labour is *Debility of the Uterus*, not disposing it to contract. This may happen in a woman otherwise strong, as a man may have a weak arm, while the rest of his body may be strong. Such a woman may have no character of weakness about her but this, so that we may not be able very readily to guess at the cause when it exists. It is not proper to give stimulants and opiates here,

to provoke contraction of the uterus; when stimuli are given, it is not recollected that they produce fever. Opiates are not quite so exceptionable; they save time to the practitioner, but in their effects we cannot govern them, else they occasionally save the woman's strength.

Another cause of difficult labour is the *irregular contraction* of the fibres of the uterus; where the longitudinal set, and the circular set, do not contract as they should do relatively to each other. This alway arises from irritation of the os uteri, in needless examinations. The patient has strong labour pains without the delivery being forwarded. We may here recommend a dose of opium; after which it is probable, that, upon their action recommencing, it will be in the natural manner.

Passions of the Mind are the next set of causes of difficult labour. The effect of them is to diminish the strength and frequency of the pains, till they at last subside altogether; and this will all occur in constitutions where the powers of action were originally very good. These things shew the necessity of keeping up the hopes of the patient to the pitch of security and confidence, for from the moment that her confidence fails her, from that moment the pains are protracted, and that merely from the state of doubt and arising anxiety. This points out the necessity of never forming a prognosis of duration; we may form, and declare our opinion as to the event, but never the length of time which the labour shall last; for if we were to speak the truth, our prognosis would be in general very unsatisfactory. If we only tell a patient it will be to-morrow before the child is born, it will depress her resolution, and damp her perseverance; the pains will diminish, and she will be all the worse for what has been said.

The *os uteri* may also become a cause of difficult labour by its being rigid. This state is natural to some women, and especially those who are somewhat advanced in life when they begin to bear, also with the first child the parts dilate more slowly than in subsequent labours. Rigidity may arise from repeated and useless examinations; and where the os uteri is rigid, it forms one of the most painful labours, accompanied with excruciating pains in the back. This state is attended with inclination to vomit and to sleep, both which things are in themselves useful; for sleep restores the strength of the body, while the vomiting strengthens the bearing down.

The os uteri, when in this rigid state, resembles inflammation, in being tender to the touch; its hardness almost reminds us of a board, which is bored through the middle with an auger. This is one of two kinds of rigid os uteri, the other description of which gives a very different feel: it is more apt to give way under the finger, is of a pulpy substance, and in some measure resembles the intestine of an animal filled with water and drawn into a circle; and though this is not so rigid to the finger as the other, yet it is longer in giving way. This sort of swelling, or thickening, is sometimes occasioned by œdema, or ecchymosis, as it has been known to arise in a quarter of an hour; at the same time it lies between the os pubis and the child's head. It generally happens, that from the pain there is a degree of fever present. But when once one part of the enlarged circle retires behind the head, the whole of it slips up, and the child is sometimes born in five minutes, if there be no resistance from the soft parts.

We must here be very cautious not to allow the woman to exhaust herself in fruitless efforts; for which reason we should explain to her that it will be of no avail that the mouth of the womb is not large enough to admit of the child's passing, and that it must be a work of time, and will be a work of time, notwithstanding all the endeavours she may make to shorten it. We should, in the meanwhile, fill up our time and keep up her attention by ordering an injection, or making some other preparation; and if the last be a six or eight ounce mixture, in case the os uteri is very irritable, and by frequent examination has been rendered more so by being deprived of its mucus, twenty drops of laudanum may be added to the mixture.

In difficult labours it will now and then happen that the *vagina* is very rigid, making considerable resistance; this very generally depends on irritation, by the interference of the midwife. The consequence is, that inflammation of the periosteum and membranes covering the bones very often arises. In such cases, patience and horizontal posture are both grand remedies: besides which, why not use fomentations, as in whitlow, or any other case where relaxation is wanted.

The next cause that impedes labour, from resistance of the soft parts, is a full bladder and suppression of urine. This is

not a formidable evil. In early examination we shall, instead of feeling the mouth of the uterus, come to the neck of the distended bladder; but in the progress of labour the child's head presses upon the neck of the bladder, which pressure causes the suppression. This will never happen if the bladder be frequently emptied in the early part of labour, because the time between the head's being at the upper aperture of the pelvis, and delivery, is in general of a moderate duration, in which no serious accumulation can take place in the bladder, unless the labour is very long. When it is necessary to draw off the urine, the catheter will enter the meatus urinarius with greater ease if its curve be a little increased. With regard to a woman in this situation, we should never rest satisfied that her bladder is not dangerously full, because we see a little water which has passed without the instrument. We must never allow the woman's delicacy, or dislike, to prevent our examining: we must represent to her the importance of it; for if she die from a burst bladder, it will be a very deplorable circumstance, as it is so easily prevented.

Contraction of the Vagina forms another impediment to labour. If this be the consequence of a cicatrix it will sometimes be proper to divide it by a knife, in order to allow the child's head to pass through; when we attempt to divide it high up, we are in a very delicate situation on account of the bladder and rectum; and if the head have passed so far forward as to come into view, it will be adviseable to leave it to nature. Excrescences arising from the os uteri or vagina may impede labour, though these causes in general only produce slight difficulty; the os uteri has been known to be in such a state from a tumor on its side, that only two-thirds of the circle have dilated for the passage of the child's head. In most cases the tumor is pushed aside, so that it occupies a protected situation during labour, and the head passes very well.

An *unfavourable state of the Ovum* may protract labour. It is said, that the navel-string may be tied round the neck of the child in its passage through; by which the effect of each pain is lost, being held on each side by the string, it is forced a little forward in each pain, retiring again as soon as the pain goes off. It dees not appear likely, however, that this ever happens, because the effect attributed to the elasticity of the cord, may be seen in every labour from the elasticity of the soft parts, and more particularly where the head is larger than the cavity of the pelvis. So that there is no reason to believe this to be a cause of difficult labour. Yet we may now speak of its treatment, when it does occur. The cord is frequently turned round the neck of the child when the circulation is not in the least interrupted; in this case we have only to turn it off the neck, and if the circulation be felt, leave it. Where the loop round the neck is tight, so as to interrupt the pulse, we may loosen it by passing the finger between it and the skin of the neck, so as to feel the pulse again. It has been said to be sometimes so tight as not to admit of its being slackened at all. This is just possible, and the most improbable thing in the world. It is then to be divided between two ligatures.

Rigidity of the Membranes has been stated to produce difficult labour. It has been observed, labour was quicker when the membranes were ruptured early; but though the labour is slower, it is safer where the membranes are unruptured. Where the membranes are to be opened, there have been a great number of pretty looking instruments invented for doing it. Long tubes, at the end of which blades or points were projected. But it requires more skill in telling where they should be let alone, than where they should be meddled with. With the first child they must never be broken: the inferior parts of the passage dilate but slowly, and require the assistance which the membranes are capable of giving. But in subsequent labours, perhaps, it may be admissible, where the pelvis and soft parts are known to be capacious and yielding. The time when they should be broken is when the head may be received into the os uteri upon their breaking. Never must they be broken before the os uteri is of the proper size; if they be, we cause a continual drivelling of the waters, which in itself is productive of great delay. It will often protract the labour two days: it has been known to protract it three weeks.

A frequent cause of *the Rupture of the Membranes* is the using too violent exercise for the parts to bear. The riding in a coach over the rough stones will bring it on, as the weaker part will always give way first. Another cause of the membranes giving way may be the death of the child, for dead members will give way when a living member will not give way.

The next cause of difficult labour is in the

disproportionate size of the Child's Head, compared with the cavity of the pelvis. This is not mollities ossium; but a disease which, independent of that, is capable of producing considerable difficulty. The different size of the head will regulate the progress of the labour. The head may be so large as not to pass, and this increased size of the head may be combined with a state of pelvis, which in shape resembles a man's; which pelvis would not admit a head of an ordinary size. The head may also be accidentally larger than it should be, for two heads of the same absolute size shall in labour prove to be of different sizes: that is, the first shall give way, and allow of compression by the soft parts; while the second, by being more perfectly ossified, will not allow the bones to slip one over the other, as in the first instance; for which reason one of these two heads will, in effect, be larger than the other. The volume of the head may be also increased by a descent of one or both the hands; or it may occupy undue space by a wrong position. In all these cases, instead of trusting to time, or using instruments, we may generally afford relief by introducing the fingers and turning the head aright.

Independently of these difficulties there are others of a totally different class; and which produce difficulty chiefly by rendering a labour more complex. The first which we shall notice, is the presentation of the *umbilical funis*.

We have already explained that the fœtal life is that of a fish; that it is furnished with an apparatus resembling gills; that the funis is analogous to the pulmonary artery and vein; and that the circulation through it, if stopped, produces death upon the same principle that suffocation does to an animal which breathes. Hence the importance of the funis presenting. Let what part will present, arms, legs, shoulders, or breech, it is of consequence from this circumstance chiefly. It is of no consequence in regard to the woman's safety, and all treatment is applicable merely upon the simple ground of preserving the child's life while labour goes forward. From whatever cause the funis has presented, the effect is the same, and the treatment must be directed by the circumstances of the case. Suppose the membranes lately broken, and the os uteri pretty fully dilated, the funis down. The best practice here, will be to turn the child, and bring down the feet; as this affords the best chance for saving the child's life; though where this happens with the first child, it is as well to let it remain, for the operation of turning will then of itself produce the death of the child. Suppose the head in the pelvis, and the navel string pulsating in the vagina; the best way is to return the navel-string, and follow it up with a long strip of cloth, or handkerchief, artfully pushed up, so as effectually to prevent its coming down again; and as this is the only chance that we have of keeping it above the pelvis, it should never be left undone; and at last the head will get so far down, that it can be delivered by the forceps immediately. In all cases we should recollect that the woman's safety never must be hazarded by doing that which will only obtain a precarious chance for saving the life of the child.

Plurality of Children. The disposition to multiply is general throughout the whole creation; even in vegetables it is not unusual to see two kernels in one nut; and the sheep, instead of having one lamb, will sometimes bring two. All uniparous animals may have two young ones, though in some species it is more frequent than in others; it is not so common for a mare to have two foals, as for the ewe to have two lambs. In the human subject twins occur once in about forty-eight labours; this calculation is taken from the lying-in hospitals of London, Edinburgh, and Dublin. There are sometimes more than two; as three, four, and five; but such instances are extremely rare. Dr. Osborn mentions a case where in an early miscarriage he saw six distinct ova, each complete; and there is a monument in Holland to a woman, who, the inscription declares, had 365 children. But it signifies not, whether there is one or 365 in the uterus, for each has still its distinct bag of membranes each its own placenta; though sometimes the placentæ are joined so closely, that they would almost seem one cake.

There is no mark by which we can distinguish twins till after the birth of one child. It has been said that labour is then more slow than at other times; but this would imply that single labours were never slow, which happens to be very far from true. Another opinion is, that the woman is bigger than in other labours, and this would seem to be very natural; but it certainly is not very true, but very much the contrary; and many practitioners have declared that they have never once been right in their opinion upon this subject. So that the dif-

ficulty of the labour at first will depend on itself without any reference to the child. But after one child is born, we can easily lay our hand upon the abdomen, and determine the point: not forgetting that where there are more than one child, the placenta must never be brought down till the last child is delivered; for if we use any force so as to detach a part of the placenta from the uterus we produce a flooding. If the abdomen be examined before delivery, we shall feel the tumor reaching high up to the scrobiculus cordis; if after delivery, we shall perceive a rounded tumor lying on one side above the pelvis like a foot-ball. If we examine the abdomen in a twin case, after one child is delivered, we shall not be able to say, from the diminished size of the tumor, that one child has come away.

When we have ascertained that a second child remains in the uterus, we should wait quietly, and without communicating the fact to the patient herself lest we alarm her, till by a recurrence of the pains we find the part that presents; and if it be an arm or shoulder, we should tuck up the sleeve of our shirt, and pass up the hand greased into the uterus, without any preparation on the part of **the** woman; it is here better avoided, and the child may be turned at once. The one child has already passed, therefore the contractions of the uterus and vagina will be a smaller impediment here, than in any other case. Before we thus act, however, it will be better to leave the patient to recruit herself awhile. If the practitioner be a young man, it is best to wait about four hours, before he does any thing towards the delivering the second child; an experienced person probably need not wait so long. If we wait four hours, no harm can happen from hastening the delivery; we have waited so long as to justify ourselves in the eyes of all the world.

A twin case is not quite so safe as a single birth; [illegible] without our being able to give the least reason for it. As there have been some fatal instances, we should be upon our guard not to say there is no danger in such a case; we may say they are commonly not cases of danger, but should not, when asked, affirm that they are perfectly safe.

Convulsions. Cases of puerperal convulsion bear a strong analogy to epileptic fits: so much so, that it is nearly impossible to distinguish them at first sight, excepting from the different degree of violence attending each: the fit of puerperal convulsion being much more violent than any fit of epilepsy. The paroxysm is so violent, indeed, that a woman, who, when in health was by no means strong, has shaken the whole room with her exertions.

Puerperal convulsions may occasionally arise at any time between the sixth month and the completion of labour; they seldom or never happen before the sixth month. They may arise as the first symptom of labour, in the course of labour, or after the labour is in other respects finished. Puerperal convulsions have these characters belonging to them; they always occur in paroxysms, and those paroxysms occur periodically like labour pains; so that there is a considerable space, perhaps two hours, between the two first attacks; after this, they become more frequent. They not only occur with the labour pains, but in the intervals; and whether there have been labour pains or not, before they come on we shall always find the os uteri dilated, and it is sure to become dilated from the continuance of these convulsions; and at length, if the woman be not relieved and the convulsions continue without killing her, the child is actually expelled, without any labour pain at all: On opening such cases after death, where the convulsions have been violent, the child has been found partly expelled from the contraction of the uterus; which power is capable of expelling it even after death. In one case in which it happened, the whole child was expelled except the head.

It is a disease depending on the uterus, and brought on by the labour pains; or if arising before them, is of itself capable of expelling the child, if the woman survive long enough. It occurs in all presentations: sometimes with the first child, and sometimes with those born afterwards. It resembles hysteria, as well as epilepsy; but is more violent than either. No force can restrain a woman when in these convulsions, be the same woman naturally ever so weak. The distortion of the countenance again is beyond any thing that can be conceived: in regard to deformity, surpassing any thing the imagination of the most extravagant painter ever furnished; nothing bears any resemblance to the progress of this disease; the rapidity with which the eyes open and shut, the sudden twirlings of the mouth, are altogether frightful, dreadful, and inconceivable.

These convulsions are by no means external only; respiration is first affected with

a hissing, and catching. The patient stretches herself out, and immediately the convulsion begins. The next symptom which arises comes on after the convulsive motions have continued in their utmost violence for a time; the woman foams at the mouth, and snores like an apoplectic patient, indicating great fulness about the brain. These symptoms are succeeded by a comatose sleep, out of which she awakes astonished, on being told what has happened, not in the least aware that she has been in a fit; and then she will fall into another fit, out of which she will again recover as before. It rarely happens that the understanding is taken away in this disease until it has been repeated several times. In the fit the skin becomes dark and purple, proving that the circulation through the lungs is not free, which purple colour leaves the woman gradually after the fit is gone: and it is not only the external parts of the muscles of respiration that are affected here, but the uterus also. This is known by introducing the hand; when the convulsions come on the uterus will contract, but with a tremulous undetermined sort of force, perfectly different from what it does at any other time.

There are two cases of puerperal convulsions which are very distinct: one is a convulsion dependant on some organic affection of the brain; the other on an irritable state of the nervous system. Where puerperal convulsion arises from the former, but more especially from fulness of vessels, or extravasation, it is always preceded by some symptoms, which, if watched, will enable us to relieve, if the patient send in time, which however is rarely done.

In a patient strongly disposed to this complaint, there will be a sense of great fullness in the region of the brain, which amounts even to pressure, giddiness in the latter periods of pregnancy, dizziness in the head, and a sensation of weight when the head stoops forward, which gives her the idea that she shall not be able to raise it again; imperfect vision; bodies dancing before the eyes, sometimes dark, at others luminous. This state of the eye denotes fullness of the vessels of the head more surely than any other symptom, and if allowed to continue, will lead to extravasation and puerperal convulsion. The disturbed vision is a very strong symptom, and must never be passed over. If attended to early, even though symptoms of the complaint be present, still it may, by timely assiduity on our part, be prevented from ending in premature labour.

Here repeated bleeding and purgatives are all in all; the sole object being to take off stimuli. After bleeding, and before any aperient is given by the mouth, we should give a solution of soft soap in warm water as an injection; it is the quickest as well as the surest means: then a purgative mixture, with manna and Epsom salts. By these means, that is, by bleeding, purging, and the abstinence of all solid food and wine, no more blood is made; what the patient has is diminished, and she gets gradually better.

When convulsion arises from a general irritable state of nerves, it is difficult to distinguish the disease before it becomes established. It is most frequent in large towns, and in those women who lead the most indolent life; hence it is found in the first circles of fashion, in preference to the others; and there is one grand circumstance which has great influence in its production, that is, a woman's being with child when she should not. Being obliged to live in a state of seclusion from society for some months, perhaps she reflects and broods over every thing which relates to her situation, and which gives her pain. She recollects she is not to enjoy the society of the babe she has borne, but on the contrary will be obliged perhaps to part with it for ever. She is afraid of her situation being known, and that she shall be considered an outcast in society. In this way she will brood in solitude, till at last the mere irritation of labour may be sufficient to excite puerperal convulsion. The difference between this kind of puerperal convulsions and the other, does not probably exist in any thing visible: it is not possible to tell the difference exactly; but just as it is coming on, the woman will complain suddenly of a violent pain in her head, or stomach, which is expressed in the same way by all women; they all say they cannot survive the pain if it return. The mode of treatment will not essentially vary from that already mentioned. Our plan, however, should be less active, and opiates may be allowed to succeed it.

These observations relate to convulsions antecedently to labour. We now proceed to the same disease during labour.

It has sometimes happened, that a woman has died of the first convulsion; but it happens much more frequently that a number come on in succession, arising either before or after delivery. The patient very

rarely dies in the fit, though she die from convulsion: she dies in the comatose state which succeeds to the fit; and if we be suddenly called to a patient in this state, where we are unable to learn the circumstance of the case, and we evidently see there is a great fullness about the head, we should immediately open a vein, and draw blood largely, being regulated by the appearance of the body and what we are able to learn from those around. From twelve to twenty ounces may be the extent of the first bleeding; if the disease go on, and the os uteri do not admit of delivery from its not being in the least dilated, the convulsions not gone off, and the pulse in such a state as admits of it, we should bleed again, and again. Some practitioners have with the greatest advantage taken sixty ounces of blood in a day. A woman in this state will admit of divided bleedings very largely. This takes off the pressure from the brain, made by the blood while in its vessels; and also the chance of its being extravasated. This must be done immediately: then the head must be shaved, and a large blister applied over the whole cranium. The next means of relieving is getting the bowels into action as quickly as possible; first, by throwing up a soft soap solution in the form of injection, and then by giving a concentrated solution of some neutral salt with infusion of senna.

If it be a case of convulsions depending on irritation, we may certainly do something more by the use of opiates; and here we must be limited in the quantity of blood which may be taken away. The proportion must be small compared with that proper in plethora. Eight or ten ounces will be a full bleeding; and if it be necessary to take more, we may apply leeches to the temples, never neglecting the bowels, which must be kept very open. It has been directed that the patient be put into a warm bath; but experience contradicts its use; the fits have been found to be more violent in it, and the patient is liable to bruise herself in it, and be otherwise much injured.

It is an extremely dangerous disease: it is impossible for her brain to bear the violent pressure of her situation; opium, in cases of irritation, is proper, and should be given to the greatest possible extent. With this we may join the affusion of cold water. This, when resolved on, must not be done by sprinkling a little out of a bason upon the patient's face; but we must have both a full and an empty pail, the patient's head being brought over the side of the bed; and before the fit has come on, we may, as in other convulsions, detect its approach by attending to the intercostal muscles, the vibrations of which will warn us that no time is to be lost: when we should immediately discharge the whole over the head at once. Whenever this complaint occurs at or near the time of labour, it is uniformly right to deliver: to dilate the os uteri, and deliver immediately. We should deliver in all cases where it is practicable; for this is the only cure for puerperal convulsions.

If convulsions occur some days after labour, it should be treated as the same disease in other cases.

Rupture of the Uterus. This was formerly considered as a very rare occurrence, though it probably happened oftener than practitioners were aware of. We have many descriptions of sudden deaths in labour, the symptoms of which exactly correspond with those known to attend ruptured uterus. It may be divided into two kinds, spontaneous and accidental: the first happening most commonly in the cervix uteri, and the last in any part of the uterus.

Spontaneous rupture occurs suddenly and unexpectedly, and always without any warning, and for this reason, that it depends on the irregular action of the muscular fibres, and all muscular contraction is immediate. It most commonly happens, that when the head of the child is in the cervix uteri, the lower segment of the uterus is received into the upper aperture of the pelvis, and the aperture of the pelvis without the uterus is opposite to the bones of the head within the uterus; the consequence is, that the uterus is pressed firmly between the two forces: from the pressure being applied in this situation, the longitudinal fibres can only contract from the pressed circle towards the fundus; and upon this principle it will not tear at the extremity, but will tear from the part so pressed upon; the rent once made may run in any direction.

Accidental rupture occurs from the action of the uterus being violent while the hand of the practitioner is within, or the same thing may happen from pressure of the knee or some other part of the child, which last is frequently the cause.

The manner in which the uterus gives way in this instance, is exactly a fibre contracting over a pulley, which being a disadvantageous position is liable to be ruptured

if the contraction be strong. Certain symptoms take place which are evidences of its having happened; one is a sensation of a sudden and most excruciating pain, which always comes on at the moment of the rupture. A lady, when in labour, was attended by a most respectable practitioner, and a man in years; this case is an example of the manner in which it may come on. The labour went on perfectly well, and it being late at night, he proposed that the husband should go to bed, as his wife would be delivered in three or four hours more. The gentleman then sat down by the bedside of his patient, and in about three quarters of an hour she began to scream suddenly; he supposed the head was in the vagina, as the labour had gone on so well, when to his astonishment he found the head was not to be felt, it had entirely receded. She would get up, and he in vain prayed and begged her to lie still. This state of pain and restlessness was succeeded by faintness from two causes, hæmorrhage, and pain. These are attended with another, which is the sudden loss of labour pains. There is a faint inclination in the uterus to keep them up, but they are sure to sink. The organ is destroyed, and its functions must necessarily be destroyed too. There is great restlessness, accompanied with a sense of pain different from that lately felt: there will be faintness, but without loss of blood externally, for it generally passes into the abdomen; there will be vomiting of a tenacious chocolate coloured fluid; the head or other presenting part recedes usually, and the child can be no longer felt.

All these symptoms combined, become a proof of ruptured uterus; but any one of the symptoms may occur alone; the patient may be in violent pain without rupturing the uterus; she may faint, but it does not follow that her uterus is torn: there must be all these things in common; excruciating pain, a fainting, sickness, and vomiting of that singular kind, and the retiring of the presenting part; these in the aggregate will determine our opinion. If in a case of this kind we find the head has only entered the upper aperture of the pelvis, we cannot get the forceps applied: here it has been said we might turn and bring down the feet: but this should never be attempted; it only occasions more mischief; the only chance is to open the head of the child. If, however, from the head being high up, and loose, we think that we can embrace it with the forceps, we may try, for we by this mean give another chance for the delivery of a living child, which is a great object at all times.

Suppose a case where the child has actually retired from the cavity of the uterus into the cavity of the abdomen, what is to be done? there have been different opinions; some say it is best to bring the child back, while others leave it to nature. It should always be returned and delivered by the feet. The chance is something in favour of the mother, whose case cannot be worse, and largely in favour of the child.

Uterine Hæmorrhage. Flooding cases belong naturally to this section, hæmorrhage being one of the constant attendants on the last mentioned accident. We have already considered the history and management of trifling floodings occurring in the six first months of pregnancy, when speaking of the management of abortion: what we are now going to treat of, relates to the three last months, the commencement of labour, during the progress of labour, or after the delivery of the child, and before that of the placenta; and each of these divisions, as regards time, will run into the rest.

The proximate cause of puerperal floodings is in all cases the same thing, consisting of a partial separation of the surface of the placenta from that of the uterus. The difference existing in structure, between the human placenta, and that of brutes, accounts for it happening less frequently in them than in us. In quadrupeds, the fœtal part separates from the maternal portion, as was before explained; while in us the whole placenta comes away entire, leaving vessels with open mouths; so that when any portion of the placenta is separated by any mischance, a consequent hæmorrhage attends, which is proportioned in violence and duration to the extent of the part so exposed. The vessels are largest towards the middle of the placenta; and some of them are very large indeed on the inner surface of the uterus.

The occasional causes of the uterine hæmorrhage may be any circumstance capable of separating a portion of the placenta from the inside of the uterus. These were enumerated when speaking of abortion: all acute diseases, passions of the mind, as rage, &c. strong liquors in large quantities; and besides these, if the placenta be attached close to, or over the os uteri, it will be very likely to produce hæmorrhage, either before or in labour. When it is attached

on the cervix uteri, it must in the course of the labour be separated by the dilatation of the uterus at its neck; this is so plain, that it cannot require illustration. Such a situated placenta will almost ensure uterine hæmorrhage in the last months of pregnancy, which may be more or less in quantity.

If it be very slight, the necessary means to restrain it need be nothing more than what is used in slight hæmorrhage from any other part: but when violent, and the patient either gets one gush of blood, or it comes in quantity till she faints, and then it is restrained, and she gradually recovers; and then it recurs from her taking some stimulus into her system, either food or drink; she has no sooner recovered a little strength, than another bleeding comes on, and she will faint and recover, and the flooding again recur, and so on; the faintness causing the restriction of the vessels; the restriction of the vessels allowing the circulation time to restore its own equilibrium; and when once that has arisen, the force of the circulating blood again overcomes the slight resistance formed by the contraction of the vessels, and the formation of the coagulum.

When once a woman has had an uterine hæmorrhage, from whatever it has proceeded, she is never safe; and must remain in jeopardy every hour, until she is delivered, for the slightest circumstance may reproduce it after it has once happened. The danger in this state is not from the quantity of blood lost, so much as the manner. A bleeding has come on at the third month, which was exceedingly large in quantity, but in consequence of its not flowing very quick, the woman has survived. Miscarriages occur in which a large quantity of blood is frequently lost, without the woman dying; insomuch, that where abortion takes place in the tenth week, she very rarely dies from loss of blood, though sometimes this is excessive. What then does this depend upon? the time in which it is lost, and the way in which it comes on; for although lost from the constitution, it is from small vessels. But when there is a sudden gush of blood from large vessels, the case is quite different. From experience we know that large vessels do not contract so soon as small ones; there is not time for faintness to intervene, and the patient consequently dies immediately.

One symptom of the greatest danger in a flooding case is a want of labour pains, when it occurs in labour, which is the reason that the midwife hardly ever sends for us till it is too late; she thinks nothing can be necessary to be done till the pains go on as they should do, while in fact their subsiding is one of the worst symptoms. It shows that the uterus has not energy enough left to expel the child; so that we always judge uterine hæmorrhage to be worse when not attended with pain than what it is. Another bad symptom is, when the os uteri feels relaxed and flabby like a piece of dead meat, with a hole through the middle of it. It resembles an inanimate opening; we may without resistance move its lips in any direction. When the hæmorrhage continues long, the face loses its colour, the mouth and lips become quite pale, and the little projection at the inner canthus of the eye is a very significant part with an attentive observer; it is not often attended to, but if it be sunk, it is a symptom of decided danger; these are followed by want of rest; the patient will be moving about in bed, and that notwithstanding all that we can say, if we even represent the risk of her producing her own death by it, still she will be throwing her arms in every direction, and rolling backwards and forwards in the bed. In this way then will she proceed, one fainting fit succeeding another, at last, so rapidly, that it can scarcely be conceived until seen: fits of vomiting towards the end will occur, together with a sort of convulsive raising and lowering of the pomum adami; and life will at last leave her suddenly; perhaps after she has been speaking she will lay her head down and die. The next danger is, that *she may* drain to death, by a slow progressive state of the complaint. To day she *shall* lose a pint of blood, to-morrow half a pint, next day none, the day after that again a quart, and so on, till the powers of life are exhausted. Thus is she drained to death; for the stomach is not capable of supplying nourishment quick enough to counteract so rapid a consumption.

There are still other dangers arising from uterine hæmorrhage, the consequence of which we have great reason to fear. Suppose a woman in labour loses two quarts of blood by the vessels of the uterus, that woman will, about the fourth day, have a perfect fever in all its characters, somewhat resembling the milk-fever, the pulse 120, the countenance flushed, the skin hot and parched, though we should naturally enough expect, that instead of producing fever, the loss of two quarts of blood might more

readily be expected to take fever off where it existed before. Supposing even that the patient gets quite clear from any return of the hæmorrhage, the fear that remains is, whether she have not already too much for the constitution to repair; and we must again wait in expectation of the fever; if that do not come on, so much the better; that is another danger got over. But she may die at the end of twelve months, and that from the effects of a single attack of this complaint. This will in most instances happen in women who are of a flabby loose texture, and have a heavy fat body. Hydrothorax, or ascites, will in these persons supervene at a great distance of time, entirely from the debilitating effects of the loss of so large a quantity of blood has induced.

With regard to the powers by which hæmorrhage is naturally restrained in different parts of the body, we may say that they are two in number; one of which is the contraction of the blood vessels themselves, the other is the coagulation of the blood in the mouths of the vessels which are ruptured. With regard to the contraction of blood vessels, it is well known that an hæmorrhage is frequently stopped by that power alone. If we prick our finger, or shave a bit off, it would bleed everlastingly, were it not for the contraction of the divided branches, which stops it, and that so effectually, that if from time to time we even wipe away the blood with a sponge to prevent any assistance which might arise from the formation of coagulum, yet the bleeding will stop. But as the vessels contract gradually and slowly, the blood which forms on the surface being exposed to the air coagulates, and becomes the second cause of the blood ceasing to flow from the divided vessels. So that hæmorrhage, considered in general, may be said to be restrained partly by the contraction of vessels, and partly by the coagulation of blood in the vessels. The natural powers by which hæmorrhage is usually restrained are the coagulation of the blood as it flows, and the contraction of the vessels. To these a third power is added in the uterus; it is the contraction of the organ itself, and it is not only one of the three, but the most important, as being the most effectual power of them all, in stopping the hemorrhages which flow from the internal surface of the uterus. It should appear also from the experiments of Hewson, that the coagulation of the blood is more rapid in animals when dying than at any other period; hence he argues that coagulation is always in proportion to necessity.

With regard to *treatment* we may observe, that in slight cases, where the quantity of blood lost is very trifling, it will not be necessary to notice the existing state of pregnancy, but to make use of the common remedies for the checking of slight hæmorrhage from any internal part. But if there be increased action of the heart and arteries, and we know the constitution will bear it, we may take away ten ounces of blood, and suppress the animal food; moderating the sanguiferous action, so that there shall be no risk of displacing the newly-formed coagulum, in its recent state, a tender jelly. If these things are attended to, the blood will perfectly cork up the bleeding orifices of the ruptured vessels. We should at the same time empty the bowels, prohibit all stimulating aliment, and advise a horizontal position. All this, however, refers to slight cases, and an early period; if after this period, or during labour, we must seldom be beguiled from more active measures. The only solid security is a delivery of the child, which in all cases of profuse or continued hæmorrhage we should immediately prepare; and in the process to be pursued we are of course to turn the child.

Wherever, in doing this, the os uteri very easily gives way, it is the very essence of danger, proving the want of contraction in the uterus. In the present instance, however, we do not want to empty the uterus so much as we wish for its contraction; for if we get away its contents at a time when it cannot or will not contract, we do no good. If the placenta seal up the os uteri, we must go directly through: we may easily, indeed, screw, our hand through it, for it is a loose pulpy mass easily torn. We should not wait long, nor be afraid, and, if the labour be recent, we may turn the head and bring down the feet: if the head be low enough to apply the forceps, we may deliver in this manner. The whole of this practice lies in a very small compass; in determining to deliver early, and in determining that our patient shall not die; and it is founded on the principle that hæmorrhage from the uterus cannot be restrained by the two powers which are sufficient for stopping a flow of blood in most other parts of the body, by the contraction of the vessels, and the coagulation of the blood in them; and that nature has here appointed

a third power, by the presence of which the human uterus differs from that of all other animals. It is right, however, after turning, and bringing down the feet, to allow the child to remain undelivered for a short time, attending to the least pain that may be felt, and gently assisting in the forwarding the expulsion; and when the child is born, to wait the action of the uterus again for the expulsion of the placenta; for we must still recollect the grand object is the contraction of the uterus, without which, its being emptied would produce very little good. It will then happen, that the same contraction which expels the placenta will diminish the area of the vessels, and the danger from flooding ceases. But if this contraction do not take place soon, and the hæmorrage continue for some minutes after the extraction of the child, we must consider whether the strength will not be lost, and the safety of our patient endangered: if so, the placenta without delay must be separated by introducing our hand.

Immoderate Discharge of the Lochia. The next view of uterine hæmorrhage, is that where it does not stop on the extraction of the placenta. Such cases as these are very rare; there may be a sudden gush of blood, and often is, following the placenta; the reason of which is, that the uterus, at the time it expels the placenta, forces down every particle of blood with it; and in this way a pound or a pound and a half may escape, but that need not be regarded in the least; it does not affect the constitution, because it was not evacuated immediately from vessels; it was lying in the uterus. So when we amputate a limb, there is no loss of blood to the constitution, because the whole of the blood which is taken away is necessary to the limb, and no longer necessary than while the limb was to be supplied. But supposing that from the vessels not being properly secured in the operation, there is a bleeding afterwards from the stump, then it is that the constitution suffers; there is a demand made upon the mass of circulating fluids, which must be replaced before the heart can recover its proper balance in the system. Apply this to the uterus, and we shall consider the blood as belonging to the gravid uterus, and not to the circulating system. This is what is, in the practice of physic, called an immoderate discharge of the locia. Such hæmorrhages frequently arise from the cord being pulled with two great violence, by which the placenta comes to be injured; and this happening when the uterus is not disposed to contract, the vessels will, for a time, remain exposed and bleed, This is the reason why it happens so frequently in the hands of bad practitioners, as midwives; and that it is so rare when no improper treatment is adopted in regard to the placenta.

Now supposing the hæmorrhage yet remains, that is, after the uterus is emptied, the child born, and the placenta come away; what are the means next to be employed to restrain the hæmorrhage? the application of cold, and the abstraction of heat in every possible way; we should take the clothes from the bed, leave nothing but a sheet to cover, and that from motives of decency alone. If there be a fire in the room it must be put out; the windows kept open to preserve a cool and fresh air, and if the patient be faint she may have a cup of cold water.

Cold water and ice are the proper applications both to the parts themselves and the body round them. The coldest water made colder by throwing two handsful of salt into a couple of quarts of it, may be used by cloths many times doubled dipped in this, and laid over the back and abdomen; besides which, we may with the greatest advantage expose the body to a great degree of cold, if it can be done.

If these means do not answer, we must introduce ice into the vagina, or even uterus; this will often succeed; if this be ineffectual, we must as the last resource plug up the vagina with lint or tow, or something capable of entangling the blood; for while there is a clear channel there will be no coagulum formed. If the flooding still continue, the best plan is that of carrying something permanently cold into the uterus itself; a large dossil of lint, dipped in the cold solution, will carry up a degree of cold; but the best thing is to carry up a piece of ice, and allow it to thaw in the uterus. Dr. Baillie, of New York, who was the first who introduced the use of cold applications here, was in the habit of using a ball of snow for this purpose, which often stopped it directly, when nothing else would. Ice being introduced into the vagina, will often prevent abortion; this then is the best and last remedy in floodings; if none of these things will stop it, there is nothing else that will.

After the hæmorrhage has ceased, the patient will be so reduced, so exhausted,

the action of the heart so weak, and the quantity of blood circulating so deficient, that our first care must be to supply the waste, and remove the greatest danger, which is that of the patient's having been exhausted beyond the point at which the constitution is able to rally, and recover itself. These cases must be supported and stimulated; boiled milk with grated crumbs of bread in it, must be quickly cooled by spreading it on a flat dish, and when cool may be given as one of the most nutritious things that can be had; or good broth in which the grated bread is mixed; and if these remedies do not stimulate the heart and arteries, the probability is that the patient will die. In many of these cases the best stimulant is the volatile alkali, next to which brandy and water, or the ammonia, which is preferable, because, although the first effects of the spirits is good, it produces too much heat in the system at large, while that effect never arises from the volatile alkali. It is sometimes two, or even three hours, before we can leave such a patient in the certainty of her living.

After the flooding has stopped, we are not to consider the patient as safe. The fever coming on about the third day, may be troublesome; nothing is so efficacious for this as the saline draughts, with laudanum to the amount of a grain of opium in the twenty-four hours. Immersing the hands and feet in warm water to about 80° Fahrenheit is useful; it brings down the pulse, and does a great deal of general service.

After flooding, another circumstance requires attending to, a throbbing of the head and loss of memory, which will remain for weeks: in such cases there is nothing so good as purging, although the cause of the complaint be hemorrhage. The best way is to give infusion of senna with the Epsom salts, after which a draught of the decoction of bark.

Consequences of the Placenta remaining, and its treatment. The general treatment of the placenta has been already explained, where nothing more than ordinary attends it, together with the proper time which it may be allowed to remain. We will now consider the consequence of its remaining, and its treatment when it does remain.

It was said before, when it remained too long, it was necessary to pass up the hand, and bring it away by separating it from the uterus. Some say, that immediately after the child is born we should go up and bring it away, if the same pain which expelled the child do not separate and bring down the placenta. This is said to save another unnecessary pain. It is said that the uterus will afterwards contract, and all will be well. The truth is, the uterus is meant to expel the placenta as well as the child: if it were necessary to have extracted the placenta directly as the child was born, nature would have made some further provision: all the works of nature are perfect in all their parts. There is a case in Haller where it was left to nature, and remained, it is said, thirty days. We should never think of leaving our patient while the placenta remains behind. When a woman is properly managed, it will rarely be necessary to separate with the hand. In this Dr. Hunter's practice was exceptionable; he was in the habit of leaving this to nature: he used to leave the woman upon the child's being born, desiring the nurse to put the placenta into the bason when it did come away; that was enough for him.

We should never leave the placenta in the uterus; and if we have left it two hours, we should never leave it beyond that time. It is always right to bring it away. If it adhere to the uterus, we may introduce our hand as in turning, guiding the hand by the cord; we should then separate the edges of the placenta from the uterus, peeling it gradually and carefully off. After the whole is separated, we may make a feint to withdraw our hand to observe if the uterus will contract; if it do not, we should use a degree of pressure against its side, and it will generally bring on its action.

The placenta may be retained by a contracted uterus, of which there are two kinds, one in which the uterus is as long as before delivery, but narrower. This state will depend on too speedy delivery. We must patiently overcome the contraction with our hand, and separate and bring away the placenta, as in other situations. There is little hazard in this case, as the ready contraction gives us little reason to fear the ill effects of hæmorrhage after we have got away the placenta. The other sort of contraction is that in which the uterus may be said to resemble an hour glass, called therefore the hour glass contraction; this must be overcome in the same way as the other. Whenever we introduce our hand to bring away the placenta, we must take care to bring away the whole; it has been stated that a part of it has been found in a state of schirrous adhesion to the uterus; now it certainly will adhere, that often happens:

but of schirrous adhesion we know nothing. However we should always do a thing perfectly: if we set out with the intention of doing it at all, we should do it completely. It is better to leave the whole than a part; because if the whole be left, most probably the uterus will contract upon it, since it is a stimulus which the uterus is able to act upon, while part of it cannot be acted upon by the uterus with the same facility.

Consequences of a portion of the Placenta remaining. Pursuing the subject, we come next to the consideration of that state which arises from a portion of the placenta being left. No great inconvenience seems to arise till the third or fourth day, when the lochial discharge increases and becomes more offensive; the after pains, which generally cease about the third day, remain after that time, arising from the tendency in the uterus to throw off what it cannot get rid of. There is occasionally a shivering fit, succeeded by heat, but rarely ending in perspiration. The pulse rises to 120 or 130, the patient becoming emaciated and very pale, though when the fever is upon her she looks as if painted: by degrees the hectic flush lessens; the pulse becoming smaller, acquires a wiry hardness, and this continues: the woman becomes tender at the lower part of the belly when it is pressed upon, though it is not violent pain as in puerperal inflammation; frequent retching and vomiting now arise: and if she live long enough, hiccup succeeds to the last symptom, together with which the mouth and tongue become sore: she is at length worn out by all this, and lays down her head and dies.

The discharge becoming greater and more offensive is the best marked symptom, and frequently causes the death of the woman. This does not strike those people who happen to attend without being practitioners in midwifery; they see the fever, which they attribute to the effects of lying in, and they hope it will soon get better.

Inverted Uterus. This happens most frequently in the practice of female midwives, they being more in the habit of pulling away the placenta; and they in this way invert [illegible] upon the same principle that the finger of a glove is inverted when a [illegible] the middle knotted to the end of the finger, and then drawn down the [illegible]

In inversion, at the [illegible] it will often happen that the placenta will separate from the uterus at the same time that the inversion takes place, and the operator is not aware of what has happened; now, however this is produced, the effect is in all cases the same; it may be attended with profuse flooding, or the uterus may contract: it is lucky if a flooding come on, since it may lead to an examination, when the tumour will be felt in the vagina, and must be returned, the fundus being reduced first. It should be done as early as possible. The difficulty consists in the os uteri forming a sort of ligature behind, which prevents the return of the uterus through it. When the os uteri is before us it is easily dilated; but when we have to work through a substance to it the case is changed. Sometimes hæmorrhage will take place early after delivery; and whenever it does, we should always examine: there is no difficulty in examining, and it ensures the safety of our patient. If we know of the case directly it has happened, and we return it, there is an end of the mischief; but if we neglect to ascertain its existence till the next day only, we stand a very fair chance of losing our patient: it will be hardly possible to reduce it unless attempted directly. It is then of the utmost consequence that the practitioner be careful in extracting the placenta; and that he never pull the cord forcibly, till upon passing his finger up the vagina he feel the root of the placenta; for he may be then satisfied that it has separated.

Reviewing then what has been said upon this division of labours, we find that it comprises difficulties of two descriptions; the one resulting from what has been called cases of arrest, or of impaction; and the other from merely collateral circumstances. It is rarely that the aid of instruments can be of service, or even employed in the latter description; while they may very frequently be of the utmost assistance in the former. We call it a case of arrest when the head is got down into the pelvis, and remains unmoved, not because there is too much resistance, but because the woman is too weak for any further exertion. The state of things in arrest is very different from that which happens in impaction: in arrest we find the head not compressed, nor the scalp drawn into folds or swelled, the stools come away naturally, and the woman makes water easily: and with regard to the constitution, it is languid and weak, in short she is a very debilitated woman. What then will be the consequence in this view of the case? Is the woman likely to overcome the difficulties [illegible] the pains are worse? No. Is there any danger with regard to

the constitution? No. While there is a number of little pains which last four or five days, is it right to leave a woman? No. Then why not deliver her with the forceps, in which there is no danger; it is only bringing along the child, while the mother has not power sufficient to do it herself. In a case of impaction the powers of a woman may be as good as those of any woman in the highest health. But there is a resistanee which cannot be overcome, so that things are very differently situated to what occurs in arrest only. The bones of the head are wrapped over each other, the scalp is swelled and wrinkled, and is so altered, that upon any person feeling it who had never been at a labour, he would guess it to be any part but what it is. If it be a genuine case of impaction, the head will be locked in the surrounding parts, producing a stoppage of the evacuations of stool and urine; so that on this account it would be clear that the head filled the aperture of the pelvis.

In the next place we must attend to the constitutional changes. For the first twenty-four hours after being taken in labour the woman works away very vigorously; while during the last twelve hours the labour will hardly make any progress, and she is sweating extremely. This state will at last change; it will gradually sink down to a mumbling half delirious state, wandering and low. No woman should be allowed to go into this state; and if she be in such a situation, she should not be allowed to remain in it. For if the pressure of the vessels upon the brain be allowed to continue, she will become apoplectic. Besides, there will be harm done to the abdominal muscles. What good will be done by allowing the woman to deliver herself, if the vagina and bladder slough with the parts around, which is another thing that may happen? In a consultation that was held in a case of this kind, it was agreed that nature certainly should be able to deliver the woman: she therefore was not interfered with; she did deliver herself, but lost her life for it; she died, and that at a time when an ear was to be felt, which certainly was a piece of barbarity. It is safe to assert, that if, after we are able to feel the ear, the woman is not delivered in six hours, we ought always to deliver with instruments. We know that in strangulated hernia nature has, in one case out of 50,000, made an artificial anus through the side, after the parts themselves have sloughed off. But are we for that reason to avoid operating for the strangulated hernia? Are we to leave the patient to the powers of nature? There is not any difference between pushing a man into the water, and not helping him out of it, if we see him drowning; neither in the same way is there any difference between destroying a woman purposely, and neglecting to employ those means which, when she is in danger, will certainly save her life. There are many other cases in which the forceps may with propriety be used: hœmoptoe, syncope, flooding, presentation of the navel string, rupture of the uterus; all these occurrences justify its application, provided the case is within the power of management by these means, either forming impaction or arrest.

We proceed, therefore, to examine into the origin and nature of the instruments usually and advantageously employed on such occasions.

ORIGIN AND USE OF INSTRUMENTS.

Sometime towards the latter end of the century before last, two instruments were invented; the vectis, and the forceps.

The *vectis* is what the name implies, a lever which is intended to assist the delivery of the child's head. The forceps consists of two levers joined to each other in such a way that the fulcrum of each blade is found in the opposite half of the instrument.

In employing a lever there are three points to be considered; the point of action, the moving power, and the fulcrum or intermediate space between the two. In using, then, the vectis, the point of action is the head of the child. And here it is too obvious to need mentioning, that the force applied by the instrument must be equal to the resistance, if not superior to it; and then the mischief may arise to the parts of the child's head so acted upon, producing much injury: the ear may be injured; the lower jaw or zygomatic process of the temporal bone may be broken; or any part of the surface from the pressure may slough off: these evils are by no means imaginary; there are various instances recorded of each of them, and that under the hands of the most careful and dextrous men. When an instrument of this sort is used, it is proper to make the hand the fulcrum on which it acts: now if the force required be but small, this may certainly do well enough; but where great force is required, this is a very bad support;

besides the bony parts of the pelvis lie so convenient, that we may rest our instrument on almost any part of it; yet we should recollect that whatever part we convert into a fulcrum, we injure, more or less, according to circumstances: if we apply it over the symphysis pubis, we press upon the urethra; or if in other situations, we shall injure the clitoris, or vagina.

Wherever we find the ear, over that part is the application of the instrument to be made. The injury done to the soft parts will be greater in proportion as we attend less to their safety, than to that of the perinœum. The integuments suffer again, if we attend to the fulcrum, by which we get a lacerated perinæum. So that we either cannot use much force with the vectis, or, if we do, it will be to the certainty of doing much mischief. All these circumstances will depend, however, on the smallness of the difficulty to be overcome; and if there be no great danger, there will not be much difficulty or pressure.

The *forceps* has many advantages which are of some consequence to mention. The forceps has thinner blades than the vectis, and one objection against the use of the last instrument is, its being so very liable to do harm at its point of pressure; while another objection is, that as the force is applied higher up, so it makes the head flatter in proportion, and increases its volume in the direction in which it should be lessened. In the next place, if we consider the vectis, we find that whenever its pressure is applied to the upper part of the pelvis, it must increase the volume of the head applied to the lower part of the pelvis; while we know that the forceps, so far from increasing the size of the head itself, is capable of compressing the head in such a manner as to bring it into a less compass than before; so much so, that the head included in the blades of the forceps shall altogether occupy less space than was before occupied by the head alone. It may here be objected, yes; but the head is compressed by this means. Yet granting that it is, we know that at the same time the child is able to bear that compression without the least injury. Besides the practice is justifiable upon other grounds than that of the pressure not hurting the child: for supposing that it did hurt the brain, no more force is used than what is necessary to bring the head along the cavity. It is only compressed to the size of the pelvis, and at any rate it must come through that cavity, therefore it must inevitably suffer that compression, whether conducted through by instruments or forced through by the labour pains of the woman herself. There are cases where the head being actually too large for the cavity of the pelvis, would never get through by the exertions of the woman alone. What is to be done here? if no other resource be at hand, we must open the head: but here the forceps present, to save the child's life by the compression they are able to make. The truth is that the brain of an infant will bear pressure very well, so that as far as this goes, the forceps may always be very safely applied. We see that they do not act by any partial pressure, and that the action is diffused.

Another objection to the use of the vectis is, that it requires one of the hands to be employed as a fulcrum, in order to prevent injuring the soft parts against which it would otherwise rest: and that while the hand is so employed, the perinæum is neglected to the hazard of its being lacerated; and that if we chose rather to take care of the perinæum, the soft parts are violently pressed against the bone, by which they suffer great pain and injury.

The forceps consists, as we have already said, of two levers joined to each other in such a way that the fulcrum of each blade is found in the opposite half of the instrument; and now having two levers untied by a joint, we need not look to the pelvis to furnish the fulcrum, neither need we neglect the perinæum. There is still a query, that if the forceps be so much better than the vectis, how is it that the vectis is still in use by some? for no other reason than because it is easier to use; for one instrument requires less skill than two, and for that reason it is preferred by those who have not more skill than they know what to do with. They say they think it is best, and with them so it is. The man is simple, the instrument should therefore be simple. The complex instruments are safer in the hands of those only who have learned all the uses of them as well as the modes of managing them. Though as to instruments of every kind the knowledge of them and the way to use them dextrously can never be taught; they must be used before the management of them is acquired. It is only learned by practice; just as the habit of stopping the notes correctly on a stringed instrument of music.

In the *Application of the Forceps* we must

first learn the state of the pelvis; if that be narrow or deformed, we next calculate whether the head can pass; if it be too small, the forceps is useless. It is best never to apply it, but when we are able to include the whole in the grasp; to ascertain which, we should examine and feel the ear; when we can feel an ear, the head is within the cavity of the pelvis. The reason why we know the forceps may then be applied is this, we know the instrument to be so much longer than the finger, that if from the os externum the latter be able to reach the ear, the former will effectually encompass the head. The next thing after feeling the ear, is to ascertain the exact position of the head, which being done by examination of the sutures and fontanelles, we judge whether a change of position in the head might not enable the woman to expel the child by her own powers alone; and if we find ourselves unable to turn the head round, we may then apply the instruments to it as it lays; first feeling for the occipital bone and fontanelle: and if in examination we be able to feel the posterior fontanelle, we know that the occiput must be somewhere in the range of the pubes, which will be more precisely determined by the direction of the sagittal suture.

Supposing this known, the instruments are to be applied, the convex sides of the blades to the cavity of the sacrum, so as to accord with the direction of the axis of the pelvis. Before the introduction of the forceps, it will be necessary to dilate the parts gently, especially if it be the first child. The blades of the forceps must be greased before being passed, to ensure an easier passage, and then one blade first is passed gently up between the finger and the head of the child: because by this means we are certain no soft parts can be injured, or pinched by it; further than the finger will reach we must depend on the proper direction of the instrument, which should at its point be pressed towards the centre of the head and passed forward with a gentle rigling motion, which serves to form itself a space between the uterus and the head, taking care also to keep the handle of the forceps outward, so that we may assist our intention of keeping the point of the blade close to the head. In carrying the instrument up, we should always put the woman upon her guard to warn us if we give her much pain, because if we do, we know that we have pinched the uterus, and should then withdraw the blade a little way and return it till we get as far as necessary without much pain; which being done, the other blade is to be introduced in the same manner; which is easily accomplished after the introduction of the first. Both blades being introduced, the instrument is next to be locked; and it is convenient to pass the finger several times round the lock, to see that no hair or skin is included, which might give some uneasiness to the parent at the time of using the instrument; and before beginning to operate it will be as well to take the forceps and give it a sort of vibration or shake, that we may feel that we hold the child firmly. We should then explain to the patient that every thing relative to the application of the instrument is done; but that she must not expect our assistance will give her no pain, for it must give pain, though less than she would feel in her attempts towards expulsion while unassisted. It is not possible to bring the child into the world without pain.

Now we must remember that labour pains are not continual; therefore we must not use the forceps as if they were. The head will not bear constant pressure, therefore we must desist every now and then beginning with the least possible force that is of any use, which may be easily increased as may be necessary. We should rest frequently, and from time to time go round the head with our finger to see how the business comes forward; always satisfying ourselves that the instrument still encompasses the whole of the head. The motion we make with the forceps must be slow and gradual, inclining it very gently from side to side, or from blade to blade; always acting in a line with the axis of the pelvis, till we can feel the occiput, when we move with regard to the axis of the vagina; using in the latter part of the operation very little force, for the head requires very little force to bring it through the vagina.

Deformed Pelvis from Rickets or Mollities Ossium. In both these diseases the cavity of the pelvis is often so much contracted, that it is impossible for the child to be brought down it whole and alive by any means: and hence when we meet with deformity from either of these sources our first question should be whether there be space enough to allow the child's head to pass? and if the space be above three inches, it is sufficient, and the head may pass. Where it is less than three inches it is not sufficient,

and the head cannot pass; the question is then changed, what method have we to bring the child out of the body, if it cannot pass through the pelvis? and here it has been proposed to cut it out from the body, by the following operation.

Cæsarean Section. This has been performed in two ways, by an incision obliquely carried through the side; or through the linea alba directly down. The object proposed in this operation is to save the life both of the mother and child. It is of great antiquity. It is said that Julius Cæsar was taken this way out of the body of his mother; but there is no just ground for believing such a report: many historians held him as so remarkable a man that they were determined he should not come into the world like any other person. If it had been so, is it not strange that Pliny, who wrote so soon afterwards, should devote a chapter entirely to the history of a living child being cut out of the body of the parent who was dead, and yet mention nothing of Julius Cæsar's having come the same road. Scipio Africanus is said to have been introduced by the Cæsarean section, but there is no reason to believe it. It was never known otherwise than as an operation recommended till the sixth century in Paris. It was also once performed in Holland by a sow-gelder upon his wife. It is remarkable that the same woman was afterwards pregnant; but when her husband proposed the operation again, she declined submitting to it, and was delivered without. The surgeon who strongly recommended it in Paris, was Rousset, who never lived to see it performed, on account of the opposition he met with in opinion from Ambrose Parée and other eminent surgeons.

The manner of performing this operation has been much disputed; the lateral incision appears to be the best; because we divide one muscle and it retracts, we divide the muscle under it, and it retracts also: but the whole of the incision will not be a direct line through, so that we stand a better chance of saving our patient, as far as exclusion of the air may have a good effect, when the parts come afterwards to unite.

Of the two plans of performing the operation, the lateral incision then appears to be the best; and in making it we must attend to the following points: the woman may die under the operation itself, or shortly after, from the loss of blood; from exposure of the cavity of the abdomen, causing extensive peritoneal inflammation: from the parts suppurating, instead of uniting by the first intention; or from inflammation being so violent as to prevent the formation of matter, producing mortification. Yet if we look at the cases of this kind that are recorded, we shall see the fairest accounts that could be written, the death of the patient never being attributed to the operation, but to some trifling cause, perhaps relating to diet; such as a small glass of wine, or a few grapes producing inflammation of the peritonæum, or diarrhœa. This is decided upon without considering the probability that the diarrhœa or peritonæal inflammation may have been produced by the operation alone. These things should be considered fairly, and not viewed with the partial eye of him who has performed the operation. We see that on the continent this operation has been very rarely successful, according to Bourdelet, not in one case out of ten; and when we enquire how often it succeeds in our own country, as more nearly concerning us, we find that it has uniformly been fatal, that is, that all the patients have died from it; there is not a single solitary instance of recovery. It has been performed in London, Leicester, Edinburgh, and Manchester, by the best surgeons of these places, and there are none better in the world; but all the patients have died. Nevertheless, whenever the operation is performed, it should be done with a view of preserving both lives, because it is a safer way of delivery to open the head of the child. In mollites ossium, indeed, the disease is continually going on; no case recovers; it always destroys the woman: and here it is certainly advisable to perform the Cæsarean operation, though not with the hope of preserving both lives; but that the woman is hardly more sure of dying after the operation has been performed, than she was before.

In all cases of mollities ossium, then, the child being ascertained to be alive, the Cæsarean section should be performed; in all other cases the life of the child should give way to that of the mother: and the head should be opened.

Signs whether the Child be alive or dead. From the reluctance that every one must feel in opening the head of a child, it will be still a satisfaction to us to know whether it be alive or dead. The marks, then, are these: in the first place, supposing the child is alive, the pregnancy of the mother will continue to increase to the end of her time; and in labour the presenting parts

will have a firm elastic feel; the cuticle and hair will not come away on the finger: besides which, there will generally be a pulsation at the fontanelle. But the navel-string being pressed may cause death; it may arise, and does often arise, without any cause that we are able to trace. We know that a child may die in utero from affections of the mind in the woman. The death of the child may be known by shivering fits preceded by a sense of coldness in the abdomen. While the child is alive, it assists in supporting its own heat; but when dead, it necessarily must obtain a degree of heat by robbing the mother of part of the heat in the parts around, which explains the sense of coldness that is felt. The breasts, while the child is alive, increase and continue firm and well supported; but when the child dies, they immediately become flaccid and empty. So that a woman, frequently used to miscarriage, will foretel its approach by this alone. While the child is alive, it gives the sensation of a living weight, a weight which is capable of adapting itself to the different positions of the mother; but when death deprives it of this power, the woman feels it flap from side to side, according to the way in which she moves. She becomes sensible of weight to a much greater degree than before. Besides all which, there will be the cessation of motion in the fœtus, which is always perceived by the mother some months before delivery. These are so many signs of the child's death, which may be observed before labour comes on.

There are others which accompany labour: first, as the child is dead, the membranes will be dead also; and for that reason will break earlier than they otherwise would. It has been said, that the liquor amnii being turbid, points out the child being dead; but this circumstance sometimes arises while the child is alive and well. The strongest sign is one by which we may tell it before even we see the woman; it is by the waters being corrupted. The smell of putrefaction will sometimes decide the opinion of an experienced practitioner the instant he enters the door; also in examination, from the meconium coming away on the hand, in consequence of the sphincter muscle being putrid and relaxed. The sutures of the head vacillate like bones in a bag. When we examine, the hair and cuticle will come away upon the finger.

When all, or even the greater part, of these signs are united, there can be no possible doubt that the child is no longer alive.

In what cases the Child's Head should be opened. These cases are syncope, convulsions, hæmorrhage, on the part of the mother; hydrocephalus internus on the part of the child. This last disease may be ascertained by examination, the sutures and fontanelles being at a greater distance than they should be, and the whole cranium very imperfectly ossified; but the most unequivocal evidence is the head's not entering the pelvis; by which we know that the head is too big for the pelvis, or that the pelvis is not large enough to receive the head into it, which is the same thing in effect.

When all the stages of labour are gone through, and the head is not advanced, we are led to examine and find out what the state of the child is. When we have ascertained the existence of a deformity of pelvis, we may generally tell the space left for the child's passage, by passing the finger from before backward; that is, from the vagina; the space under the arch of the pubes, backwards and rather upwards, towards the projecting front of the sacrum, where the first lumbar vertebra rests on it. Now in a well formed pelvis this cannot be done; it is not possible to reach the sacrum in this way; but in a deformed pelvis we may ascertain the space pretty accurately: when the distance between the projecting part of the sacrum and the symphysis pubis is upwards of two inches, the delivery is very simple; it would be well if it were less so, as then it would not be so frequently adopted as at present. Many a practitioner has sacrificed a child's life at the shrine of his own ignorance. It is much easier to apply the perforator and open the head of the child, than it is to apply the forceps; in the latter some considerable skill is required, in the former none.

In what manner the Head is to be opened. The necessity for this operation being manifest, we must proceed as follows. First empty the bladder, then throw up an injection, that the rectum also may be also cleared; next, introduce the hand into the vagina up to the os uteri, upon which we are to pass the perforator, guarding the point with the utmost care, while passing it, by means of the other hand purposely introduced before the instrument. The points of this instrument are guarded by stops, by which when we push the points through the child's head, we avoid the danger of their passing too far, and by coming through the

opposite side of the head, of wounding the uterus. The way they are used is this: we bring the points upon a suture or fontanelle, recollecting that when they are introduced, the handles are close together, and consequently, that both the points form one perforator; now when, by the hand in the vagina, we have laid the points opposite the part of the head we intend to open, we press the instrument down with force sufficient to make it pass through the integuments, which, being done, and the perforator pushed in up to the stops, we are next to lay our hand between the handles, and pass it up between them to the joint. The effect of this will be, by its acting as a wedge to force asunder the points, and to dilate and tear open the sides of the wound before made; we next close the sides of it and change its position, so that the handles will have their rings in a horizontal position; we then open the instrument again as before, which gives us a cruciform opening. This being done, the perforator is next to be pushed into the head, and screwed round backward and forward, so as entirely to break down the consistence and connection of every thing within the skull; this will generally be sufficient, the pains will quickly press out the cerebrum, which may be removed from time to time; or we may scoop it out with a table-spoon.

If the pelvis be not greatly deformed, the delivery may now soon be effected; if it be, we proceed to remove the bones piecemeal, taking care to guard each piece through the vagina, by laying the scabrous edges of it against the hand, which, during the whole operation, should be in the vagina. The sides of the two points of the perforator, which come against each other when the instrument is shut, are made rough, so that as with a pair of pliars we may take hold of a bone which is too large to pass, and break. In this way we must bring away the frontal bone, and occipital bone; the temporal bones, and the parietals; after which, in order to have a firm hold, we should lay the scalp as far over the parts within as we can, making a sort of flap to lay hold of. It is best to put on a glove well greased in order to catch hold with. It will sometimes answer very well to carry up the blunt hook, with which we may occasionally be able to catch hold somewhere, so as to have a good purchase; but it is very apt to slip, as it has no point. If it do slip, we can then only pass the crotchet; in the construction of which we should observe that the flat point, at its sharp extremity, looks inward; so that if laid to a surface parallel to it in direction, it will not be able to peck into it, or wound it. When using the crotchet, we should begin with as little force as may be attended with a good effect; since, if not sufficient to bring down the head, it may be easily encreased; recollecting that whenever this instrument is using, we must always keep that hand which is within the uterus directly opposite the beak of the instrument, so that in the event of the parts of the child giving way, no accident may happen to the uterus. We should use a force that we can command; and if the pelvis be of sufficient dimensions, bring the body down without removing any more than the head; for when once the head is delivered, the body will soon follow, as it is easily compressed.

Where the deformity is very great, and the passage very small, we should begin to open the head very early in labour, puncturing whatever part we first reach, by a hole drilled up to the stops. We should then cease, and trust in some measure to that putrefaction which the moisture and warmth of the parts will be sure to produce instantly. This putrefaction will proceed very rapidly; and the bones, and indeed the whole body, will come away easier, separating from each other with infinitely less force than before they could have done. When the patient cannot be left longer with propriety, after about thirty-six hours, we may proceed to bring away piecemeal, the various bones of the cranium; the temporal, frontal, occipital, and parietal bones; after which the remaining part of the head will only be the basis of the skull, which admits of being placed in a more favourable position for passing through the pelvis; for the parietes being carefully laid over the bones whenever they may be felt exposed, it will protect the uterus from injury, and then if the remains of the head be brought forward, and doubled down with the chin to the breast, it will, in this state, be frequently capable of being delivered. This sort of labour is very tedious; it lasts a very great length of time; but it requires no skill. We must be aware, that when we have brought the head down, we must not always expect the body to follow as in other cases, but shall sometimes be obliged to bring away the whole child by pieces. It may be necessary, in order that the body may pass, to take out the heart and lungs, and every or-

gan, one after the other. All the caution that need be given, is to take care not to injure the woman in doing what we are about, neither in separating the parts, nor in bringing them away.

On facilitating Labour by turning the Child. It will sometimes happen that in spite of a slight deformity of the pelvis, we have a chance of saving the lives of both the mother and the child. And there are two modes of attempting to do this; the first is by turning the child, which will also apply to other cases, as well as deformity of the pelvis; the second, by bringing on premature labour. Turning is not the best of the two resources; but many women will submit to this, who will not submit to the proposal of bringing on premature labour.

After turning a child, we may pull it through by the feet, while we never should have been able to have delivered it without, for the uterus would not have been able to push it through, in the common way of presenting with the head to the os uteri; and if we prove able to save the child's life it is a grand point. If after we have brought the feet down, the head will not pass, even then we are only where we were at first, and can open it.

On bringing on Premature Labour. The operation that is certainly the best method of managing delivery in deformities which admit of it, is premature labour, which is founded upon these positions; that during pregnancy, the head of the child is increasing in size, to the time of delivery; so that if we take them in their gradual increase of size, it is pretty plain that one in the early months of pregnacy would pass with ease through a pelvis that would not receive it at a later period; and in this way, by considering the case in all its parts, comparing the diameter of the pelvis with the size of the head at different periods of the pregnancy, we shall be able to calculate the time when we may bring on premature labour, fixing either the seventh month, seventh and half, or eighth month, but never later; for if we do, the head will be too much ossified to submit to the pressure it must sustain, with that ease which is necessary to the delivery being perfectly safe. It may, indeed, be brought away as early as five or six months, but the child then cannot be expected to live; and if it be produced later than eight months and a half the labour will be as difficult as that at nine months.

The first step towards bringing on premature labour, is to carry up a male catheter through the vagina to the os uteri, and to introduce it with care, in such a manner as that the point of the catheter shall be in contact with the sides of the uterus, using a gentle pressure only. When the extremity of the catheter is against the membranes, but clear of the child, the instrument is to be thrust forward so as to break the membranes; and in this the catheter is preferable to a rod of silver, since as soon as the catheter enters we know the object for which we introduce it is gained; for while the instrument is still in our hand, we shall feel the waters passing off more or less; while if a solid rod be employed it may be necessary to introduce it a second time. In puncturing or breaking the membranes, it is also preferable to get the instrument some way up the side of the uterus, instead of breaking them immediately upon the os uteri, because in the latter way, the child is most frequently born dead; which depends on the different effect with regard to the flowing off of the waters, produced by the mode of puncturing or breaking the membranes.

The breaking the membranes at the side, only allows a partial escape of the waters, quite sufficient to produce a disposition to contract in the uterus, without permitting any injurious effect to arise from pressure; while on the other hand, when they are broken in the front, the whole of the waters flow away, the uterus contracts very strongly round the child, and the circulation generally suffers, and is either partially or completely interrupted. Delivery, by bringing on the action of the uterus prematurely, is for many reasons very estimable: a month or two before delivery naturally produced, the head is not only smaller, but more compressible; there is a less proportion of bone; so that if we take two heads of the same absolute size, one being of eight months formation, and the other seven, still that at seven would have the advantage in passing through a narrow pelvis. It is difficult for any one to determine the time which should apply to different pelves; but where the distance between the pubes and sacrum is under three, yet all but three inches, eight months may be allowed; where the distance is two and three quarters, seven months, and so on. Yet when a child is born at seven months it will rarely suck, and requires the utmost attention to be reared. By these means, then, we may be able to save two lives; by the Cæsarean

section we certainly lose one life; and by doing nothing we lose both.

Preternatural Labour. We now proceed to a consideration of the third class of labours, into which we have divided our subject, and which are generally denominated preternatural, or cross-births; including all presentations but those of the head. This class is naturally, therefore divisible into presentations of the lower and presentations of the upper extremities; and to this sub-division we shall adhere.

We know little of the cause of preternatural presentation; perhaps it depends on a peculiarity of form either in the uterus or pelvis. It is said to arise from accidents, because there are more instances of it in the lower walks of life: that is very true; and there are more aquiline noses among the poor people than among the rich; and more noses of every kind, because the truth is, there are more individuals in one class than in the other. Preternatural births are most likely the effects of peculiarity of shape in the parts.

Presentation of the lower Extremities. This constitutes our first division of labours of this kind, and is capable of being finished by the powers of nature alone; and the only consequence would be upon the child, to whom such delivery is not always safe; for when the feet present, and the child is gradually expelled, the child in figure forms a cone, which all along increases to the shoulders, and the head is born last of all; the navel-string would be born long before the shoulders were disengaged, the effect of which would be, that the circulation would be interrupted in the cord, and perhaps suspended; for pressing the naval string before birth, is the same as pressing the throat after it; each produces death. After this observation, we have only to remark, that when the cord comes down by the navel passing through, a portion of the cord should be drawn slack after it that it may not be stretched by the child's passing under the pubes.

When the feet or breech have presented, there is plenty of time to turn the occiput to the pubes long before the head is down. Whether one foot or the breech presents, it is better to let it come so, than to go up and bring down either one or both feet; because in breech presentations, the parts are gradually and well dilated before the cord is likely to be compressed, therefore it is safer; besides, the inferior extremities, in breech cases, lie upon the sides of the abdomen, by which they protect the navel-string lying between the two from any pressure whatever. So that we see all breech cases should be left unturned; and we may ascertain the breech from the head, by feeling the parts of generation, as well as various depressions without that uniform defined resistance which is given by the head. When the breech presents, the meconium will generally come away by the pressure squeezing it out of the abdomen. Suppose that in a breech presentation any accident happen to the woman, needing immediate delivery, it has been said that the forceps may be applied; but from frequent trials we can say that they are of no use; they are not calculated to hold such parts, and always slip off. Another plan recommended, is to get a handkerchief between the thighs and the body: this is an exceeding good purchase, but in the living subject we can scarcely do it; we cannot get it between the legs and body. If neither of [illegible] plans succeed, there is only one re[illegible]ng; this is the carrying up the blunt [illegible] and so placing it over the thighs; this cer[illegible]inly commands the delivery; and wh[illegible]e a small equally applied force is sufficient[illegible] it will be both successful and safe: but as it is self-evident that iron must be always stronger than bone, there will be a great risk of breaking the thigh-bones by this instrument. Yet the woman is not to die to save the child's thigh-bone from the risk of being broken; and it is certainly better to have to treat a child with its thigh broke, than one whose brains have been all scooped out. We should, however, be careful never to employ the least unnecessary force.

The feet being born and the breech passed, the part which next presents is the umbilicus; and as the body afterwards passes further down the cord will be both pressed and dragged; and if a cylindrical yielding cavity be dragged, the cavity of that cylinder is diminished in its calibre, and the tube will ultimately be obliterated; so that the best practice will be, as soon as a part of the umbilicus can be felt, to pass up the finger and bring down sufficient to prevent its stretching in the progress of the expulsion; and as soon as the head is in the pelvis, to bend the face down, bringing it forward upon the breast of the infant, and opposite the os externum, by which means the child will commence breathing; and if the naval-string only pulsate up to that time when breathing commences, the child

is safe in all that regards suffocation; and as to the head remaining within the os externum, it is of no consequence whatever. If the child's head cannot be brought through we may pull, drawing it with caution. Some practitioners will pull the child very hard, which is quite improper; not that it is any material object to the woman, but to the child; the force being applied with the hopes of the child's being born alive; but is it very likely that its life will be saved, after a leg or an arm is pulled off, or after the body is pulled so hard as nearly to be separated from the head?

Second division of Preternatural Labour. The other division of this class of labours, is that in which *the upper extremities present.* This is now and then an original presentation; but sometimes it is artifical. It may be called original if felt before the membranes be broken, in the absence of a pain. It may be called artificial when the hand being felt by the practitioner, perhaps with some other part, is drawn down through the os uteri, and the position of the presentation varied; though it originally was a head presentation, it may be made a shoulder presentation. When the hands are at the os uteri, they are easily distinguished from the feet by the thumb not being in the same line with the fingers; while in the foot we distinguish the toes and heel. The shoulder has been mistaken for the back, and it is a mistake easily made in practice. In distinguishing, we should recollect the superior extremities have the scapulæ behind them, while at the breech we feel the organs of generation. We may here lay down a rule, which is of the greatest consequence, and applies to all kinds of practice in midwifery; that is, that the shoulders and arm will never pass together; the labour may continue, but if that presentation be not altered the woman will be worn out and die. We must return an upper extremity; and never regard it as a matter of choice, but as a rule of practice which must always be adopted. We must turn, because it is a presentation that cannot be delivered. This altering the position of the child, in utero, is called the art of turning, which art, in modern science, is attributed to Ambrose Paree, though it is mentioned as far back as the time of Celsus, who says it is sometimes necessary; he does not, however, say whether it were ever done on a living child. Ambrose Paree's words are, "that in all cases where the upper extremities present, you must turn and bring down the feet; and if the midwife cannot do it herself she must send for a surgeon who can."

The nature of these presentations may vary so much that it may be necessary to mention some circumstances. Suppose a case in which the waters are not yet discharged, and the labour is going on very naturally, but by examination through the membranes between the pains, we find that an arm or shoulder presents, yet we may, perhaps, not know exactly the parts; in such case, we should not be absent from the woman upon any account, at the time of the membranes breaking, for it will make all the difference in the world as far as relates to that labour. We must ascertain the exact position of the child, and we must then proceed to turning. The question now is, what time in the progress of the labour is most proper for this operation? Bourdelois says, when the membranes are broken, and the os uteri dilated. Dr. Hunter is of the same opinion. Dr. Clarke differs from them both, and justly; for he found that if we delay turning till the waters have come away, and the os uteri is quite dilated, we allow it to remain to the increasing the difficulty of the operation. If we take it when the os uteri will admit the finger and knucles, it is the better time, because we then turn the child as if in a bucket of water; and this gives us so clear an advantage that it needs no explanation. This then is the most convenient period, and we should begin by dilating the os externum, previously intimating our design to the patient, cautioning her not to be in the least frightened at what we are going to say; we may then inform her "that the child does not lie quite right, but it may soon be set right, and with little trouble." It being then agreed upon, the woman is to be laid close to the edge of the bed; and we roll up the sleeve of our shirt and pin it, anoint the hand and fore-arm, and dilate by forming our hand into a cone, first going gradually through the os externum, taking our time, and being very gentle; but we should not pass on dilating beyond the vagina, until our hand passes easily through; if we do we shall feel the inconvenience of it afterwards, by the contraction of those parts: having got our hand through the vagina, we may let it remain awhile, and should a pain come on, it may waste itself on our hand. We should then gently begin again to dilate till we get our hand into the uterus; when we turn the child gradually round, bringing the head to its proper situation.

There is no difficulty if we once get our hand up through the os uteri, that being dilated sufficiently, without the membranes being broken. But suppose another labour, where the membranes are broken without the os uteri being dilated. We have here much more to do, and less chance for doing it well than we had in the other example; we must go on, and have to turn the child too, under the increased difficulty of the contraction of the uterus, which will not, indeed, be violent, but quite enough to render the turning difficult. But if we be able to manage the most easy case, and the most difficult, we shall be equal to all the subordinate or intermediate degrees of difficulty that may be met with in turning.

To give an example of the greatest degree of difficulty, suppose a case where the waters have been lost twenty-four hours, two days, or even three. What we have to do in overcoming the contraction of the uterus, is not altogether a matter of difficulty as to skill, so much as it is as to time and management. With a view to lessen the difficulty, opium has been given; but great caution is required in its exhibition; since a woman has been known to die from the use of opiates; she has been drained to death by uterine hæmorrhages.

The last circumstance necessary to notice with regard to preternatural labour is, that all the other parts being brought down, the head sometimes cannot be got through well. We may here use a moderate force, by pulling with the body, remembering that our object in using force is to save the life of the child. Besides, why should we use a force too great when we may always deliver with the forceps. Though where violence is unavoidable, it is best to open the head.

To employ that force which, without violence, may assist in bringing away the head, a good method is to make a sort of loop, by bringing a handkerchief loosely round the neck; when letting the ends down upon the breast, we tie them rather low on the breast, so that there may be plenty of room to place our hand within it to pull by, and if we succeed we must mind, that in bringing down the head, we depress the sides of the head so as to bring it into the hollow of the sacrum. If it will not come by any means, we must then open it: when we have extracted the brain we should introduce the blunt hook, and it is used with the most effect when seconded by the pulling of the body.

In some instances it happens that the head is entirely separated from the body, when various means have been recommended for bringing it away. The only sure method, however, is to open it; and when we have dilated it by expanding the perforator, we should introduce the crotchet before we withdraw the perforator, in order to have the head always secure from slipping, as it otherwise would do. The difficulty is, that whenever we touch it we have a smooth slippery surface, which we cannot keep unless we have an instrument within the hole we have made. It will roll over the upper aperture of the pelvis. We must recollect always to keep one hand in the vagina, while any operation is going on, for the extraction of any body which may be within the uterus, and in order to guard the instruments.

DISORDERS SUBSEQUENT TO DELIVERY.

Most of the diseases consequent upon pregnancy arise after delivery, and not during labour. We shall first observe, that

Quietude and a horizontal position should be strictly enjoined, as a matter of the greatest moment. And for this reason it is obvious, that as the patient should not be moved early, she ought never to be delivered in her clothes. This, however, is a plan often proposed by the lower orders of people to save inconvenience and expense; but it should never be assented to by the practitioner, as it is a very dangerous experiment to raise the patient to an erect posture, at a time when she can only remain perfectly safe in an horizontal position. There are many instances of the fatal effects of neglecting such a precaution.

A woman after delivery should remain perfectly at rest for at least two hours, and then should by no means be raised upright, but be very gently lifted just enough to allow the drawing away of the clothes, which, if they give trouble, must be cut away with scissars, to prevent the risk of exhausting the patient by over exertion.

Fainting. Fainting after delivery frequently happens, and may arise from many causes, most of which are of little consequence: it is always an unpleasant occurrence, and sometimes dangerous. It may be merely the effect of fatigue; a woman is just able to bring the child into the world, and after making perhaps the last exertion she is capable of, sinks into a faint. Frequently she will fall into an hysterical paroxysm, which will easily be perceived

by her laughing, crying, sobbing, &c. which characterizes hysteria. If the fainting proceed from either of the above causes, volatile alkali rouzes the patient, and nothing more is necessary; neither should any apprehension be felt for her safety.

Fainting may be the consequence of the great agitation of mind which the patient has suffered from fear of the approaching pains, and, as she thinks, dangers. In such cases nourishing things should be administered, as a small quantity of good broth, with a table spoonful of wine in it; or some volatile alkali.

Whenever there is reason to suspect that the fainting arises from loss of blood, the practitioner should never leave it to probability, but instantly examine the truth of his suspicions, not only on the surface lying next to him, but the upper part of the further thigh, as the blood will sometimes run over the side of the thigh that is furthest off; when the practitioner, not perceiving any discharge from that part whence it is generally observed to flow, has not the least idea of his patient's situation. When upon examination it is found that hæmorrhage has taken place, the placenta being got away, it is to be treated in the common way by acids, &c.

In some rare instances it has happened, that immediately after delivery the patient has sunk into a permanent syncope, from which she never has recovered, dying without a groan. When there is reason to suspect the approach of such a state, the patient should be made to swallow a large dose of volatile alkali; it can do no harm, and is generally highly beneficial, let the fainting originate from whatever cause. The spiritus ammoniæ comp. and tinct. lavendulæ may also be administered, and hartshorn drops should always be kept in a lying-in room.

After delivery it is advisable to apply a certain degree of pressure to the parts. This circumstance has been variously received and very generally misunderstood. A certain degree of pressure is useful; but if that pressure be too great, it will occasion worse consequences than the want of pressure altogether. The pressure required is, more properly speaking, a support, and is of the same kind as we like to feel from a waistcoat in winter. The intention to be had in view in making it, is just the same as after tapping in dropsy; and pressure judiciously applied in both cases will often prevent fainting.

Suppression of Urine. In the country it often happens, that the practitioner does not see his patient any more after leaving her safely delivered. In such cases, it will be necessary for him to leave general directions with the attendants; the most material of which is, that the nurse shall send for him, if, upon trying, the patient finds herself unable to make water, at the distance of eighteen or twenty hours after delivery. If the patient be neglected, the bladder swells to an enormous size, and at last bursts, in which case death is inevitable.

When the practitioner has been sent for, he must not be satisfied with the patient's telling him that she has since made water, and that a little escapes frequently; all this amounts to nothing, and must not excuse a moment's delay in the introduction of the catheter. It will generally be necessary to draw off the water once or twice a day; but from distance of residence this will sometimes be impossible. In such a case it is not very difficult to teach the nurse how to perform this operation, by shewing her the parts, and pointing out the little orifice, at the same time telling her, the instrument must be passed up carefully and slowly till the water flows from the other end of the tube.

Effusion of Blood into the Cellular Membrane of the Labia Pudendi. This is an accident which now and then happens after delivery. It is merely a mechanical effect of pressure, and very rarely occurs. In one case where the parts had been previously much strained, the swelling was first observed by the patient's finding herself unable to close her thighs together. This blood, if left to itself, will first coagulate round the orifice of the bleeding vessel, and afterwards the whole quantity of effused blood becomes fixed. There are two ways by which the parts may get rid of this blood, if its quantity be considerable; either by the skin sloughing off, by which part of the blood may escape, or by the part inflaming and suppurating. When the latter circumstance happens, and it is determined to open it, the orifice made cannot be too small, so that the matter be allowed to escape; for the constitutional weakness at such a time as this will give a tendency to gangrene in any part which is divided. Cold is the only application that is to be at all regarded. It has been recommended to cut and scarify the part; but this is objectionable, because, should the artery continue to bleed after the openings are made, the situation of the patient at once becomes serious, for we must ne-

cessarily be perfectly ignorant where the ruptured vessel is, and consequently as perfectly unable to stop it. Should it ulcerate, the treatment should be the same as that of an ulcer in any other part of the body.

Lochial Discharge. By this is meant that discharge which follows the expulsion of the placenta, continues for several days, and diminishes in proportion as the uterus contracts. A short time after delivery the vessels which before poured out red blood, will, from the womb having contracted to a certain degree, only ooze forth serum. When small pieces of the maternal part of the placenta remain with fragments of the membranes, &c. and mix with the lochial discharge, they constitute what the nurses call the green water; and these discharges generally subside in six or eight days, more or less. They will, however, often be reproduced by very slight causes; such as sitting upright, endeavouring to walk, eating stimulating food, or indeed any thing which may increase the action of the heart and arteries. In a strong woman of tense fibres the discharge will be of shorter duration than in a weak woman of lax fibres; if a woman be quiet it will not continue so long as if she be restless. Where the quantity is profuse, and it flows for too long a period, the constitution becomes weakened, and it is necessary to give bark with the vitriolic acid, or the conserve of roses.

Lacerated Perinæum. The intermediate part of the body situated between the vagina and rectum, is called perinæum; and from its peculiar situation is very liable to accident from the violence of pressure in labour; this will sometimes happen with the most careful practitioner; it will now and then give way in a trifling degree, and is in such cases of no further consequence than from its leaving the parts a little sore and weak for a few days. The only laceration of consequence is that from before backwards to the rectum, by which the os externum and rectum are laid into one, and the sphincter ani consequently torn asunder. This accident is, however, extremely rare, and may always be prevented by supporting that part of the perinæum with the hand.

In case of an actual laceration of the perinæum, the first step is to empty the bowels by a brisk purge; after the medicine has operated, the parts should be perfectly cleansed from all feculent matter, and then the thighs should be bandaged together, by which there is a probability of the parts uniting by the first intention, and in some cases this has succeeded. Should this fail, the only chance is not to allow the parts to heal except by uniting with each other. If considerable inflammation takes place, it must be reduced by the use of fomentations and cataplasms, and of cooling laxative medicines, and if the pain be violent, opiates may be given. When suppuration occurs, bark must be administered. The dressings may be superficial.

After Pains. Every woman who has been in labour is subject to what are called after-pains, though they do not always occur equally. They come on at regular intervals, and are more or less violent. These pains are very rarely felt after a first lying-in; and they are less when the labour has been retarded, allowing the uterus to contract gradually behind the body of the child, than where the expulsion of the child has been hastened, the uterus then contracting suddenly but not perfectly. In consequence of these pains, and the fatigue which the woman has sustained throughout the labour, it is a very general and excellent practice to give an opiate of from twenty to thirty drops of laudanum, and afterwards to repeat it in such a diminished quantity as shall allay the irritation, but not the contraction of the uterus.

An after-pain will perhaps come on an hour after delivery, by which a large coagulum may be expelled; and after that others, by which smaller coagula will be separated; and then an after-pain as violent as any of the rest, to throw off one of the smallest possible size. To some women these are very distressing, and are borne with less patience than the labour-pains, as the latter they know are for a good purpose, while the pains after delivery afford no such consolation, and yet are sometimes as violent as the worst pains of labour can be. These pains may be moderated by warm application to the abdomen, and by small doses of laudanum.

General Treatment of a Woman after Delivery. Practitioners formerly had various ways of treating a woman after delivery. Of these the principal were the high or stimulating mode of treatment; and the low or starving system.

The best practice is to avoid both of these extremes, and to treat the woman entirely according to her situation; if strong and healthy, she may be kept for a few days upon gruel, barley water, and toast and water, and then, if she be perfectly free from fever, she may eat a little animal

food. But if of a weakly constitution, she may have animal food the first day; in the former case no wine should be allowed, in the latter both wine and whatever else will nourish her should be administered. In general no meat should be allowed for the first three days; bread-pudding may be permitted, but if there be the least tendency to inflammation or fever, nothing further. With regard to medicine, much will depend upon the circumstances of the patient; the great object is to keep her quiet; and if this cannot be done without medicine, medicine must be given. A saline draught, either with or without spermaceti, will generally be sufficient; and at night a small dose of the sp. æther. vitr. co. which may be encreased if the patient's nights be restless. It is of high importance, however, to give a purge on the third day. It is of little consequence what purgative is used as long as an evacuation is produced. For many weeks before delivery the bowels of a woman are never emptied of their solid contents; and the quantity that thus accumulates is sometimes very astonishing. Should the purge not operate, an enema should be exhibited the same evening; after which not a day should be allowed to pass without a stool being procured, and this strict attention should continue for the first fortnight.

Milk Fever rarely or never happens where proper care has been taken to preserve a regularity of action in the intestines. Where the bowels are neglected, and there is a disposition to inflammatory fever, the milk being formed in considerable quantity, will greatly increase that tendency to fever.

Sore Nipples. This is a complaint often met with, and very troublesome, and most probably arises from an artificial mode of living. Many women use considerable pressure upon their breasts, and under such circumstances it is natural to expect that the nipples being pressed in, may be absorbed altogether; or if this do not take place, they will give way upon the child sucking, and become sore and painful. If this have occurred in a previous lying-in, the parts may be strengthened by applying to them astringent remedies two or three months before labour. When however soreness of the nipple has taken place, the best way to protect it is to use an artificial teat, by which the child can suck equally well, and the nipple itself being undisturbed, will soon heal. The way in which one of these instruments is prepared, is to procure a fresh teat from a heifer, and scooping out the inside, to steep the skin in spirits for an adequate length of time, and then fasten it on the glass instrument; glass is preferable, because by seeing the milk we may be assured that the child is properly nourished. A woman is capable of giving milk with a flat or even a concave surface, by drawing it out with a glass tube that has a small ball to it, by which a vacuum is produced; when immediately as the glass is removed, the child being put to the breast will keep it out by sucking till satisfied.

Where the nipple is sore, it will either be from superficial ulcers, or cracks in the skin, either of which gives excessive pain and distress; and it often happens that after all manner of things have been ineffectually applied, the nipple will heal of itself. Wine, alum solution, and all similar applications, give very great pain, though they seem to be the most beneficial remedies of any that are in use. Indeed it is extremely difficult to know what will answer best; if emollients be applied, less pain will be the immediate effect; but they make the parts more tender, which, when the child suck, will frequently bleed; and this is unpleasant for several reasons. The child probably swallows the blood, and perhaps on being sick, vomits it up again, to the great terror of the nurse, the mother, and all around them. If the sore be superficial, it will be much aggravated by sticking to the woman's clothes: in this case a little cup made of wax is a good protection. The limpet shell will answer the same purpose, the edge being covered with sealing wax; or a walnut shell may do equally well. A fresh ivy leaf laid on after every suckling is very useful, the fine glaze will prevent its sticking, and as it preserves the parts from the clothes it is very pleasant. A careless woman who does not attend to these apparent trifles, will frequently have the newly formed skin torn off from her nipple, by its fastening to the coverings of the breast. No plan however answers so well in all sore breasts as the false teat, as any application will then heal the nipple, or as it will heal without any.

Swelled Legs of Lying-in Women. This is the last disease we shall notice. It never arises before the third day, and rarely after three weeks from delivery. This disease occurs in women that have had hard labours, or easy labours; in strong constitutions, and in weak constitutions; where there is milk in abundance, and where there is none

at all; whether the lochial discharge be great or little; and whether the patient be fed high or fed low. So that there seems to be nothing either in the nature or constitution of the woman, which either causes or prevents it; neither would it appear to be affected by the labour, as it seems to arise alike under all circumstances. It is said to depend upon a translation of the lochial discharge, but this is very absurd.

It commonly begins with shivering, the swelling being perceived either general or partial in the leg; sometimes arising over the whole limb at once, and sometimes beginning in the ham. It seems to have some connexion with the absorbent glands, as it frequently commences in the groin, from which part the swelling will continue to extend till the whole leg and thigh are as large as the body: in this way the leg will be distended to the greatest possible degree, without any redness or inflammation; but it will not bear moving; if the patient be desired to move the limb, it gives her great pain. Swellings in general will pit, but this does not; and it usually occupies one side only: this is observed by Dr. White, who states that even the labium of one side shall be tumid, while the other is quite unaffected.

The swelling too is of a peculiar character; if the hand be drawn across the limb, it does not give the uniform sensation which is commonly felt in swellings; but resembles an infinite number of irregularities, difficult to be described. The best idea that can be given of it is to suppose a block, in shape resembling a leg, covered with brass nails of various sizes, and these covered with skin stretched over it. The disease is acute, and the symptoms of fever will sometimes be considerable, and then it is by no means surprizing that the secretion of milk is lessened, or the lochial discharge diminished for the reason that the circulation is determined to other parts. In ten or twelve days the hardness of the swelling ceases, and the state of the disease is changed to a true œdema, and the limb remains weak for several months. Such a limb will always be more affected by cold than the other; after any exercise, as dancing, it will be more stiff and weak the next morning than the other. This disease sometimes attacks both sides in succession; it never occasions suppuration: Dr. White indeed mentions one instance of this effect; but it is doubtful from his description whether it was this sort of swelling, for œdema sometimes resembles it very closely.

It is difficult to determine the cause of this alteration of parts, or change of organization. Dr. White attempted to explain it, by supposing that an absorbent vessel gives way at its entrance into the gland, and that the lymph still passing upwards, overflows, and enters into the cavities of the cellular membrane, and there coagulating, gives the unequal feel observed. This, however, is by no means a satisfactory explanation of the nature of the disease. It is difficult to know how we are to proceed in the cure of a disease with which we are so little acquainted. It is certainly useful to keep the bowels open, and to promote a gentle but continued perspiration. For this purpose antimonials and the saline draught will be efficacious; and when the pain is excessive, opium should be given: if the fever be considerable, abstinence from animal food will be necessary. As to the limb itself, nothing gives more ease than laying it in a soft poultice, which will also have the good effect of keeping up a gentle perspiration; it forms the softest pillow that can be imagined, and never fails to bring relief.

Treatment of Infants. It is usual in tracts upon midwifery to enter upon this subject in detail; but having already enlarged upon it under the article INFANCY, we refer our reader to what we have there advanced, which we trust will be perfectly satisfactory.

MIEGIA, in botany, a genus of the Triandria Monogynia class and order. Essential character: calyx one-flowered; corolla two valved; nectary one-valved, involving the germ; seed triquetrous rounded, included within the calyx, corolla, and nectary. There is but one species; *viz.* M. maritima, a native of the sandy coasts of Cayenne and Guiana.

MILE, *mille passus*, a measure of length or distance, containing eight furlongs, &c. See MEASURE.

The English statute mile is fourscore chains, or 1760 yards; that is 5280 feet. See CHAIN, YARD, and FOOT.

We shall here give a table of the miles in use among the principal nations of Europe, in geometrical paces, 60,000 of which make a degree of the equator.

	Geometrical paces.		Yards
Mile of Russia	750	or	1100
of Italy	1000	or	1467
of England	1250	or	1760
of Scotland and Ireland	1500	or	2200
The small league	2000	or	2933
The mean league	2500	or	3666

	Geometrical paces.		Yards.
The great league of France.	3000	or	4400
Mile of Poland	3000	or	4400
of Spain	3248	or	5028
of Germany	4000	or	5866
of Sweden	5000	or	7233
of Denmark	5000	or	7233
of Hungary	6000	or	8800

MILIUM, in botany, *millet grass*, a genus of the Triandria Digynia class and order. Natural order of Gramina, Gramineæ, or Grasses. Essential character: calyx two-valved, one-flowered; valves almost equal; corolla very short; stigmas pencil-form. There are twelve species, of which M. effusum, common millet grass, has a perennial creeping root; slender culms, three or four feet high; leaves from four to seven inches or a foot in length, thin and weak, very finely striated their whole length; panicles from four inches to a foot in length, nearly upright, spreading and loose: it appears to be much scattered, from the various lengths of the pedicels, which grow in whorls. This plant is distinguished from the panics, to which it has the greatest affinity, by having a calyx of two valves only. Native of most parts of Europe, in woods.

MILK, the fluid designed for the nourishment of young animals, and which is secreted in particular organs by the females of the class Mammalia, is a white opaque fluid, having a sweetish taste; and a specific gravity somewhat greater than that of water. When milk newly taken from the animal is allowed to remain at rest, it separates into two parts; a thick white fluid, called cream, collects on the surface, and the fluid beneath is more watery. The quantity of cream obtained from milk, and the time it requires to separate, vary according to the nature of the milk, and the temperature of the atmosphere. When the milk is allowed to stand after the spontaneous separation of the cream, it suffers another change; it first becomes acescent, and then coagulates. When the coagulum is pressed gently, a serous fluid is forced out, and the remainder is the caseous part of milk, or pure cheese. Butter and cheese are obtained artificially: the former by the operation of churning, and the milk which remains after the butter has been separated, or, as it is called, the butter-milk, has all the properties of milk from which the cream has been separated. Cheese is obtained by the addition of rennet to the milk, which is prepared by digesting the inner coat of the stomach of young animals, especially that of the calf. The quality of the cheese depends upon the quantity of cream that remains in the milk. The best cheese is obtained by coagulating the milk at the temperature of 100°, and expressing the whey slowly and gradually, without breaking down the curd. Whey expressed from coagulated milk, if boiled, and the whole curd precipitated, becomes transparent and colourless. By slow evaporation it deposits crystals of sugar, with some muriate of potash, muriate of soda, and phosphate of lime. The liquid which remains after the separation of the salts, is converted, by cooling, into a gelatinous substance. If whey be kept, it becomes sour, by the formation of an acid, which is the lactic acid; and it is to this that the spontaneous coagulation of milk after it remains at rest is owing. Milk may, after it is sour, be fermented, and it will yield a vinous intoxicating liquor. This is practised by the Tartars on the milk of the mare. Milk is likewise susceptible of the acetous fermentation. The results of very minute experiments prove that the constituent parts which enter into the composition of milk are

Milk	Muriate of soda
Oil	Muriate of potash
Curd	Phosphate of lime
Gelatine	Sulphur.
Sugar of milk	

The milk of different animals is found to be composed of nearly the same substances; but the proportions vary so much, as to give them very different properties. We shall give a brief account of the analyses of the French chemists Deyeux and Parmentier.

1. Every kind of milk, when left at rest, produces cream on the surface; but it is different in the milk of different animals. In that of the cow it is copious, thick, and yellow. In women's milk the quantity is small, and it is white and more liquid. Goat's milk produces abundance, and it is thicker and whiter than that from the cow. Ewe's milk produces as much as that of the cow, and of nearly the same colour. The cream from asses' milk resembles women's. In mare's milk it is very fluid, and similar in colour and consistence to good cow's milk before the cream appears on the surface.

2. Butter obtained from the milk of different animals is thus composed. That of the cow differs in colour; but has always much consistency. That from women's

milk is small in quantity, insipid, and of a pale yellow. The butter of asses' milk is always white, soft, and disposed to be rancid. That from goat's milk is abundant, white, and soft. The butter from ewe's milk is yellow and soft: that from mare's milk has but little consistence, and is readily decomposed.

3. The caseous part of milk varies in different animals. That from the milk of the cow is bulky, and retains much serum. That from women's milk is small in quantity, has an unctuous feel, and but a small portion of whey. The curd of asses' milk is similar to that of the women's, but not unctuous. Curd from the milk of the goat is abundant, of a firmer consistence than that of the cow, and retains less whey. Curd from ewe's milk is fat and viscid: that from mare's milk is very similar to what is obtained from women's milk.

4. The serum, or whey, constitutes a great proportion of the milk, and shews the following varieties. That from the milk of the cow has a greenish cast, a sweet taste, contains sugar of milk and neutral salts. The whey from women's milk has little colour; but contains much saccharine matter. The whey of asses' milk is colourless, and contains less salts and more sugar than that of the cow. Whey of the goat is yellowish, and contains very little sugar and saline matter. The latter is muriate of lime. The whey of ewes' milk is always colourless, and contains the smallest quantity of sugar, and but a small portion of muriate and phosphate of lime. That of mare's milk has little colour, and contains a large proportion of saccharine matter, and of saline substances.

MILL, is a machine, which by means of any adequate force, as steam, water, wind, or animal exertion, acquires such an additional power as enables the machinery to act with increased effect, and with the requisite regularity. It may be considered an axiom, from which very few, if any, deviations are to be found, that the nearer the labouring part is to the power, or origin of motion, the greater will be the force employed; but that force will be subject to such fluctuations, and to such shocks and vibrations, as to render the work inaccurate and unequal. In some operations this is of less importance than in such as are connected with minute and delicate manufactures. Thus in brass, copper, and fulling-mills, the large hammers which perform the heavy work derive their motion immediately from the great wheel which is turned by the stream; they being lifted by cogs, or teeth, set on its axis, and working without any intermediate machinery. In saw-mills, the blades which cut the timbers into planks, &c. are more removed from the great wheel by the intervention of other wheels, which not only give increased velocity, but relieve the saws from those jerks and strains to which they would be subject if deprived of those movements which render their own operations equable and firm. In corn mills the velocity is again increased by another course added to the system, while the action of the grinding parts is thus effectually discharged from all inequalities of motion; and thus flour, &c. may be ground with certainty to any desired degree of fineness, according as the distances between the stones may be regulated. With regard to the more complex movements required in the manufacture of silk, cotton, &c. many of them are so remotely connected with the moving power, that they may be made to revolve with the most wonderful exactness. It is, however, necessary, that the frame-work of a mill should be very firm and substantial; that the pinions, spindles, and axles, all move freely in their sockets, which should be exactly at right angles with them; and that no greater pressure should take place on any part than the duty it is to perform may render necessary. These great principles are inseparable from the proper construction of mills. We consider a knowledge of the powers of mechanism to be absolutely indispensable towards a due understanding of this subject; and recommend the student to refer to the head of MECHANICS for such information as may enable him to form a more correct judgment of the particulars relating to mill-work in general.

With respect to machinery moved by steam we need say little in this place; since the movements dependant on that kind of power may be found under that article, while the more remote or subordinate parts will be seen in the construction of such mills as derive their action from wind or water. The selection of the power is not always within our choice; but must depend on the abundance of fuel, the supply of water, and the due elevation of the spot where the mill is to be erected. Where coals are cheap, the steam engine being so immensely forcible, and capable of any desirable bulk, is in most instances preferred. Where fuel is dear, and that a stream of

adequate size can be applied, water becomes the momentum; but where neither of the foregoing can be found under suitable circumstances, a well-exposed spot is ordinarily selected for the erection of a windmill. We shall shew the quantity of water necessary to work a wheel of certain diameters; observing that eighteen feet has been found from experience to be the most commodious measurement, as well as sufficiently powerful for any overshot-mill: indeed for breast-mills, that diameter may be considered as capable of giving motion to all the ordinary systems of machinery. It should be observed, that the breadth of the water wheel ought to correspond with the power necessary on the occasion; supposing that a proportionate volume of water is at command; for a wheel of two feet in breadth will be more than doubly as powerful as one of only a foot in breadth; there being a double volume of water acting upon it, while the friction of the axis is by no means doubled by the added breadth.

Water is generally made to act upon machines, particularly water-wheels, by means of its momentum when in motion. We have already shewn, under the heads of HYDRAULICS and HYDROSTATICS, how water derives force from its depth, or gravity. The effect of water in motion will depend manifestly upon the quantity of fluid and its velocity jointly. Desaguliers, in his Experimental Philosophy, vol. ii. p. 419, gives the following easy mode of ascertaining these data. "Observe a place where the banks of the river are steep, and nearly parallel, so as to make a kind of trough for the water to run through; then by taking the depth in various parts of the stream's breadth, obtain a correct section of the river. Stretch one line over it at right angles, and another at a small distance above or below, but perfectly parallel. Now throw in some buoyant body (such as an apple, which will not float so high as to be affected by the wind) immediately above the upper line: observe the time it occupies in passing from one to the other string. Thus you ascertain how many feet the current runs in a second, or in a minute. Then having the two sections, i. e. one at each line, reduce them to a mean depth, and compute the area of the mean section, which being multiplied by the distance between the lines will give the solid contents of the intermediate volume of fluid, which in the noted time passed from one string to the other. Now this way, by the rule of three, is adapted to any portion of time; the question being merely if the velocity be such in such an area, or trough, what would be the velocity in another of less size. It is obvious, that if the area give twelve solid feet, and that water passed at the rate of four feet in a second, through a conduit of one foot square; if the conduit were only six inches square, the velocity would be as 16 to 4; or in other words quadrupled. The arch of a bridge is an excellent station for observing the force of a stream; because the sides are there regular, and the intermediate space may be correctly ascertained. But the depth is not always to be ascertained in such places without the aid of a boat, or of two intelligent assistants, who should be very correct in their observations."

The late Mr. John Smeaton made a variety of experiments on the powers, velocities, and friction attendant upon water wheels, of various sizes, and under different influences. He observed, that, in regard to power, it is most accurately measured by the raising of a weight to any given height in a given time: according to the weight raised, the height, and the time, so is the product to the power by which it is effected. For a power that can raise ten pounds to the height of ten feet in one second will correspond with that power which in the same period can raise five pounds to twenty feet in height; it being evident that the products must be the same. But in such case the power is supposed to be equable, without the least acceleration or diminution of velocity: and even then we are rather to consider this as a popular and simple mode of estimation; for the quantity of motion extinguished, or produced, and not the product of the weight and height, is the true, unequivocal, and perfect measure of mechanical power really expended, or the mechanical effect actually produced: these two are always equal and opposite. Yet it is true that Mr. Smeaton's mode is most applicable to the cases in which he adopts it.

To compute the effects of water-wheels with precision, it is necessary to ascertain, 1. The real velocity of the water which impinges or acts upon the wheel; 2. the quantity of water expended in a given time; and, 3. how much of the power is counterbalanced, or lost, by the friction of the machinery. Mr. Smeaton established, after a variety of experiments, that the mean power of a volume of water 15 inches in height gave 8.96 feet of velocity in each minute to a wheel on which it impinged. The com-

putation of the power to produce such an effect, allowing the head of water to be 105.8 inches, gave 264.7 pounds of water descending in one minute through the space of fifteen inches: therefore 264.7, multipied by 15, was equal to 3,970. But as that power is found equal to raising no more than 9.375 pounds to the height of 135 inches, it was manifest that a major part of the power was lost; for the multiplication of these two sums amounted to no more than 1,266; of course the friction was equal to ⅔ths of the power.

Mr. Smeaton considers the above to be the maximum single effect of water upon an undershot wheel, where the fall is fifteen inches. The remainder of power, it is plain, must be equal to that of the velocity of the wheel itself, multiplied into the weight of the water, which in this case brings the true proportion between the power and the effect to be as 3,849 to 1,266; or as 11 to 4.

Where a wheel revolved 86 times in a minute, the velocity of the water must have been equal to 86 circumferences of the wheel; which, according to the dimensions of the apparatus used by Mr. Smeaton, was as 86 to 30, or as 20 to 7.* The greatest load with which the wheel would move was 9 *lb.* 6 *oz.*; by 12 *lb.* it was entirely stopt. From this we are to conclude, as Mr. Smeaton did, that the impulse of the water is more than double what our theory states it to be. This he accounts for by the wheel being placed in a narrow slit; so that the water could not escape but by passing with the wheel's motion; thus giving a multiplied force. Further, it is to be remarked, that when a float-board comes in contact with the water, it receives a certain check, which causes the back, or upper part of the float-board to become loaded with a kind of wane, which accumulates in consequence of the momentary impediment, and consequently adds to the impetus. This added force must ever be in proportion to the depth to which the float-board sinks into the stream; not exceeding its whole depth beyond the rim, or body, of the wheel to which it is attached.

The following conclusions result from the velocities of wheels, as acted upon by different heights of water. 1. The head, or altitude, being the same, the effect will be proportioned to the quantity of water expended: or in other words according to the weight and velocity of the impinging fluid. 2. The expence or quantity of water being the same, the effect will be nearly in proportion to the height of the head. 3. The quantity of water expended being the same, the effect is nearly as the square of the velocity. 4. The aperture whence the fluid issues being the same, the effect will be nearly as the cube of the velocity. Hence, if water passes out of an aperture in the same section, but with different velocities, the expence will be proportioned to the velocity; therefore, if the expence be not proportioned to the velocity, the section of the water cannot be the same. 5. The virtual head, or that from which we calculate the power, bears no proportion to the head-water; but when the aperture is larger, or the velocity of the water less, they approach nearer to a coincidence: consequently in the large openings of mills and sluices, where great quantities of water are discharged from moderate areas, the head of water, and the virtual head (determined from the velocity) will nearly agree, as experience proves. 6. The most general proportion between the power and the effect is as 10 to 3; the extremes are 10 to 3, 2, down to 10, 2.8. 7. The proportion of velocity between the water and the wheel is usually as 5 to 2. 8. Although we have no certain maximum of the power of a wheel; that is, what it will carry, and no more; we may generally consider the limits to be, that wheels which work freely with 15, will stop when 20 are opposed to their motion: consequently when 3 is the effect, 4 will stop the work. But in general we find it extremely difficult to ascertain this point; though in works that are perfectly well executed, and where the powers, with the resistances, are judiciously computed, the quantity of the latter necessary to produce equilibrium, which here amounts to cessation, will be found to correspond with that scale.

Speaking of float-boards, it may be proper to state, that they should be rather numerous than few. Mr. Smeaton found, that in undershot mills, when he reduced the number of floats from twenty-four to twelve, the effect was reduced one-half, because the water escaped between the floats without touching them; but when he added a circular sweep of such length, that before one float-board quitted it another had entered it, he found the former effect nearly restored.

This mode more particularly applies to breast wheels, or such as receive the water immediately below the level of the axis. In such the circular trough is indispensable; because the water would not communicate

the full effect desirable from the joint operations of velocity and weight. In this kind of wheels it is proper that the floatboards should be confined both at their sides and at their extremities, so that the water may accompany all the way from the head down to the lowest part of the wheel, whence it should draw off with sufficient readiness to allow the succeeding fall to supply its place, without being in the least retarded. It should be understood, that any quantity of water remaining in the trough, at the bottom of a breast-wheel in particular, must tend more or less to oppose its motion, in the exact ratio with the disposition of the fluid to become stagnate or stationary.

The over-shot wheel is by far the most powerful; both because it receives the water at the very commencement of descent, and that the buckets with which this kind of wheel is ordinarily furnished retain the power until they gradually discharge their contents, as these buckets successively become inferior parts of the circumference. It should be stated in this place, that much may be effected by allowing the water merely to flow upon the upper part of the wheel, into the superior buckets, whereby an immense auxiliary power is erected as they successively become filled. Add to this the discovery made by Mr. Smeaton, that "the more slowly any body descends by the force of gravity, while acting upon any piece of machinery, the more of that force will be spent upon it, and consequently the effect will be the greater." That effect is by no means increased in proportion to the velocity of the wheel's motion; on the contrary, Mr. Smeaton found, that when his wheel, which was two feet in diameter, revolved 20 times in a minute, its effect was greatest: when it made only 18¼ turns the effect was irregular: and when so laden as not to make 18 turns, the wheel was overpowered by the load. He found that 30 turns in the minute occasioned a loss of about $\frac{1}{20}$th, and that when turned 30 times in a minute, the diminution of effect was nearly one-fourth of its powers. This proportion may be easily estimated on any wheel of greater extent, by computing the proportion of accumulated power lost by greater velocity than may be sufficient to load the wheel by means of the buckets being filled; observing that the progress of a machine may be so much retarded as to cause the effect to be irrelevant of the purpose, although the machine may be kept in motion. Some machines do their work well, simply in consequence of a certain celerity, as is generally the case in a grinding apparatus: thus also every person conversant in the practice of agriculture is sensible, that, when a plough is drawn at a certain pace, it will cut the soil regularly and freely, while, on the other hand, the same cattle proceeding at a very slow pace shall be more fatigued with doing less work, and that work by no means so neatly executed. All things considered, it will perhaps be found, that the great wheels of all machines ought to move at such a rate as to cause their circumferences to pass over three feet in each second of time. We could instance several very large wheels, erected within the last five or six years, which scarcely make more than one revolution in the minute, but which operate so forcibly on the counter-wheels, as to give an astonishing degree of firmness as well as of regularity to their motions.

The maximum load for an overshot wheel is that which reduces the circumference of the wheel to its proper velocity, which is known by dividing the effect it ought to produce in a given time by the space intended to be described by the circumference of the wheel in the same time. The quotient will be the resistance overcome at the circumference of the wheel; it is equal to the load required, including the friction and the resistance of the machinery. So much, however, depends on the proper precautions for reducing the friction of the several moving parts, that too much stress cannot be laid on that highly important consideration. We therefore solicit those readers who may wish to render themselves conversant in this branch of science, and especially if practical knowledge is in view, to refer to the article FRICTION, where they will find many very necessary points treated of with as much attention to their interests as our limits could allow.

We may, in theory, suppose a wheel to be capable of overcoming any resistance whatever; yet we always find, in practice, that the wheel stops, or at least is incapable of progressive motion, when the opposition or load is equal to the sum of the water contained in all the buckets. In this we speak of overshot wheels, which designation includes all that carry the water with them in their descent, and do not depend so much on its velocity as its weight: hence many kinds of breast-wheels, which are constructed according to the above plan, are by many persons classed with overshots; the latter,

however, strictly speaking, applies solely to such as receive their impulse somewhere above their centres; generally indeed at their summits. The breast-wheel, when well constructed, may carry an effect equal to half, or even to three-fifths of the power; while the overshot wheel ordinarily works with a result equal to four-fifths of the momentum: but Mr. Smeaton thinks the generality (owing to a want of exact levels, and of a due fitting and squaring of the parts, together with an inattention to the removal of friction,) do not perform work beyond half the power. Many attempt too great velocity, which, as already shewn, produces considerable diminution of power. Mons. Parent, whose principles were considered by Desaguliers and Maclaurin to be perfectly correct, considered that the wheel should move with about ⅓ths the velocity of the water: that ratio combining the essential points of receiving the full force of the stream, and enabling the engineer to regulate the interior or dependant parts in such a manner as might answer their intended purposes, and give perfect effect to the whole. As to the velocity of the stream, that cannot always be made to equal our wishes, on account of the scanty supplies in the many instances where greater falls, or more impetuous force, would prove highly valuable. It is, however, generally in our power to diminish the velocity by means of sluices, overflows, &c. so as to carry off any redundancy, and to limit the power within the bounds of safety and utility. But we trust it has already been partially shewn, that by confining a stream within more narrow bounds than its natural banks may afford, the velocity may be considerably increased; and we presume it must have been already understood, that by giving additional height to the fall, or head, whence the water flows upon the wheel, velocity, or at least power, may be greatly augmented.

While on this part of our subject, it may be proper to state, that it is in almost every instance strongly advisable to form a large reservoir, and to uphold a sufficient quantity of water, by means of a dam, &c. to afford a supply in case of long-continued drought. Such an excess can rarely prove inconvenient; the only cases in which it might perhaps not be eligible are, where the supply may be considered as infallible, or the expense prove too great a drawback on the profits of the concern.

We shall now give a description of a double corn mill, of the most common sort. See Plate Mill-Work.

A B is a water wheel, which is over-shot 11 feet 6 inches in diameter, with 36 buckets to receive the water, whose weight puts it in motion. The wheel is fixed upon a very strong axis or shaft, C, one end of which rests on D, and the other on E, within the mill-house. On this shaft or axis, and within the mill-house, is a wheel, F, about 8 or 9 feet in diameter, having cogs, 72 in number, all round, which work in the 23 upright staves or rounds of a trundle, G, fixed on a strong upright shaft, T, which has a cog-wheel, W, with 56 teeth fixed on its upper end to give a rotary motion to the two small trundles, *g g*, on each side, and which are exactly similar to each other. Each trundle is fixed upon a strong iron axis called the spindle, the lower end of which turns in a brass foot fixed at H, in a horizontal beam, H, called the bridgetree; the upper end of the spindle turns in a wooden bush, fixed into the nether millstone which lies upon the beams in the floor, I. The top of the spindle above the bush is square, and goes into a square hole in a strong iron cross, *a b*, called the rynd, under which, and close to the bush, is a round piece of thick leather upon the spindle, which it turns round at the same time as it does the rynd. The rynd is let into grooves in the under surface of the running mill-stone, K, and so turns it round in the same time as the trundle, *g*, is turned round by the cog-wheel, W; this mill-stone has a large hole quite through its middle, called the eye of the stone, through which the middle part of the rynd and upper end of the spindle may be seen, whilst the four ends of the rynd lie below the stone in their grooves. One end of the bridge-tree, which supports the spindle, rests upon the wall, whilst the other is let into a beam called the brayer, L M. The brayer rests in the wall at L; the other end, M, hangs by a strong iron rod which goes through the floor, I, and has a screw-nut at its top; by the turning of which nut the end, M, of the brayer is raised or depressed at pleasure, and consequently the bridge-tree and the upper mill-stone. By this means the upper mill-stone may be set as close to the under one, or raised as high from it as the miller pleases. The nearer the mill-stones are to each other the finer the corn is ground, and the more remote from each other the coarser. The upper mill-stone is enclosed in a round box, which does not touch it any where, and is about an inch distant from its edge all round. On the top of this box stands a frame for holding the hopper, P, to which is hung

the shoe, Q, by two lines fastened to the hinder part of it, fixed upon hooks in the hopper, and by one end of the string, R, fastened to the fore-part of it; the other end being twisted round a pin, in a convenient place, within the reach of the miller; as the pin is turned one way the string draws up the shoe closer to the hopper, and so lessens the aperture between them; and as the pin is turned the other way it lets down the shoe and enlarges the aperture.

If the shoe is drawn up quite to the hopper no corn can fall from the hopper into the mill, if it is let down a little some will fall, and the quantity will be more or less according as the shoe is more or less let down; for the hopper is open at bottom, and there is a hole in the bottom of the shoe, not directly under the bottom of the hopper, but nearer to the lower end of the shoe, over the middle eye of the mill-stone. There is a square on the top of the spindle on which is put the feeder, *f*; this feeder, as the spindle turns round, jogs the shoe three times in every revolution, and so causes the corn to run constantly down from the hopper, through the shoe, into the eye of the mill-stone, where it falls upon the top of the rynd, and is, by the motion of the rynd and the leather under it, thrown below the upper stone, and ground between it and the lower one. The violent motion of the stone creates a centrifugal force in the corn going round with it, by which means it gets further and further from the centre, as in a spiral, in every revolution until it is quite thrown out, and being then ground it falls through a spout, called the mill-eye, into a trough placed to receive it.

When the mill is fed too fast the corn bears up the stone and is ground too fast, and besides, it clogs the mill so as to make it go too slow; when the mill is too slowly fed it goes too fast; and the stones, by their attrition, are apt to strike fire: both these inconveniences are avoided by turning the pin backward or forward, which draws up or lets down the shoe, and thus regulates the feeding as the miller sees convenient.

It affords us pleasure in being able to lay before the reader reduced copies of two designs for water-wheels, by the late Mr. John Smeaton, and which we have obtained from Sir Joseph Banks, K. B. who has permitted our draughtsmen to make copies of Mr. Smeaton's original drawings, which are in his possession. The first is an undershot water-wheel. See fig. 1. Plate II. Mill-work.

A is the main shaft, or axis, upon which the wheel turns, and which communicates its power to the interior mechanism of the mill: *a a a a* are six arms morticed into this shaft, and supporting the rim, *b b*, of the wheel; into this rim the starts, *e e*, are morticed; these are short pieces of wood, to which the float boards, *f f*, are nailed; it is by the action of the water upon these that the wheel is turned: *g g* are boards fixed obliquely, and extending from one float to the next; they are to prevent the water passing through the wheel without acting upon it. B B is a circular breasting, or sweep, which is made to fit to the wheel as close as possible without touching, so that very little water may escape; the ends of the boards also fit the sides of the wheel-race, or trough, in the same manner. D D is the crown of the breasting, which is a segment of a circle. And, *d* is the shuttle by which the quantity of water going to the wheel is regulated, and consequently its power. There are two of the rims, *b b*, (though only one is seen, the other being behind it) with separate sets of arms and starts to support the float-boards at each end; and in some very broad wheels three rings are employed.

Figure 2. is an over-shot water-wheel, as designed by Mr. Smeaton, and generally recommended by him in the latter years of his business.

A is the main shaft, with two sets of clasp arms embracing it, and supporting two rings (one only of which, *a a*, is seen, the other being behind it) parallel to each other, and at the distance apart of the breadth of the wheel: *b b* are a number of boards nailed down to the rings, at their ends, in the same manner as flooring-boards are nailed upon the joists, and forming, upon the wheel, a complete cylinder: on each of the ends of these boards a circular ring, *d d*, is fixed, and between these the boards forming the buckets are fastened, by having their ends let into grooves made in the inside of the rings, *d d*; the bucket-boards are each composed of two pieces, as is sufficiently explained in the figure. The pen-trough, which brings the water to the wheel, is next to be described; it is a long square trough, B B, with a hole in its bottom at one end, through which it delivers its water upon the wheel: *e* is a board called the shuttle, covering this hole, and made to fit water-tight upon the bottom of the trough by leather; it is drawn backwards or forwards by a rod connecting it with a lever

l, by which the miller can draw it: *h* is a beam across the pen-trough: and, *k* an iron bolt to support the bottom of the trough; the edge of the hole over which the water runs, is the distance of one bucket beyond the perpendicular line going through the centre of the wheel; and it is formed of iron plate, with a sharp edge, to avoid dropping; the edge of the shuttle is also covered with iron plate, that the water may be delivered clean and in one entire sheet. The first-mentioned iron plate is bent so as to deliver the water nearly horizontally. The wheel is inclosed in a close breasting of stone, D D.

Attempts have been made to construct water-wheels which receive the impulse obliquely, like the sails of a common windmill. By this means a slow but deep river could be made to drive our mills; though much power would be lost by the obliquity. Dr. Robison describes one that was very powerful; it was a very long cylindrical frame, having a plate standing out from it, about a foot broad, and surrounding it with a very oblique spiral, like a cork-screw. This was immersed nearly a quarter of its diameter (which was 12 feet), having its axis in the direction of the stream. By the work performed, it seemed more powerful than a common wheel that occupied the same breadth of the river. Its length was not less than 20 feet: had it been twice as long it would have nearly doubled its power, without occupying more of the water-way. Perhaps such a spiral continued quite to the axis, and moving in a suitable canal, wholly filled by the stream, might be an advantageous way of employing a deep and slow current.

An under shot mill, with oblique float-boards, was invented by the late Mr. Besant of Brompton, it promises to be of great service in some situations. In common water-wheels more than half the quantity of that fluid passes from the gate through the wheel without affording it any assistance: the action of the floats is resisted by the incumbent atmosphere, at the moment when these leave the tail-water: and, as a similar proportion of water, with that which passed between the floats and the head, necessarily flows between them at the tail, the motion of the wheel is greatly impeded. On the contrary, by Mr. Besant's contrivance, no water can pass except that which acts with all its force on the extremity of the wheel; and, as the floats emerge from the water in an oblique direction, the weight of the atmosphere is thus prevented from taking any effect. A great advantage of this construction is, that the wheel works lighter, owing to a tendency to floating. When working in deep tail-water it is decidedly superior; carrying weight in the proportion of three to one.

Messrs. Polfreeman and Co. lately purchased the patent-right given to Mr. Hawkins for his invention of floating water-mills, and established one, by permission of the Board of Navigation, on the Thames. This kind of mill might be more generally used, with great advantage to the public; and, in lieu of being constructed as tide-mills (which require that the work should all revolve either with or against the sun), would, perhaps, be something improved by allowing the hulks, in which they are built, to swing round, like vessels at single anchor, in the tide's way.

Mills, *wind*, are, in their general construction, much the same as water mills; adverting to the difference of the power by which they are acted upon. The external apparatus consists chiefly of the sails, or vanes, which are commonly four, placed in nearly a vertical position, and giving, as they turn, a rotatory motion to an axis inclining but little from the horizon. The form of the arms and vanes being so well known, we shall refrain from describing them in this place.

The direction of the wind being extremely uncertain, it becomes necessary to have some contrivance for turning the sails towards it: for this purpose two modes are in more general use. In one, the whole machine is sustained upon a moveable arbor, or axis, perpendicular to the horizon, and supported by a strong stand, or foot, very firmly fixed in the earth: thus by means of a lever the whole may be turned round to any direction. In the other way, only the upper part is moveable; the roof being a kind of cap joining to the axis on which the sails, or vanes, are fixed, and working round by means of an endless screw, that acts upon a ratchet frame, embracing the lower part of the cap. The former mode applies chiefly to what are called post-mills; the latter, to fixed-mills built of masonry.

We offer the following table of velocity and power, resulting from the experiments of Mr. Smeaton, and confirmed by Dr. Hutton, Mr. Rouse, &c. By it our readers will be able to compute to any extent, when on the subject of the wind's progress

VELOCITY OF THE WIND.		Perpendicular Force on one Square Foot in Avd. Pounds.
Miles in one Hour.	= Feet in one Second.	
1	1.47	.005
2	2.93	.020
3	4.40	.044
4	5.87	.079
5	7.33	.123
10	14.67	.492
15	22.00	1.107
20	29.34	1.968
25	36.67	3.075
30	44.01	4.429
35	51.34	6.027
40	58.68	7.873
45	66.01	9.963
50	73.35	12.300
60	88.02	17.715
80	117.36	31.490
100	146.70	49.200

Whatever varieties may arise as to the internal structure of wind-mills, there are certain rules with regard to the position, shape, and magnitude of sails, which will bring them into the best state to receive the action of the wind, and to produce a full effect. M. Parent set his sails, or vanes, at an angle of 55° from the axis on which they project; and that would have certainly proved the best if no other object than the acquisition of a certain degree of velocity had been desirable; but we find that from 72° to 75° gives a greater power; consequently, in their general application, vanes standing at that angle, or within one or two degrees, more or less, are best calculated to produce a sufficient impetus for light breezes.

Mr. Smeaton made several experiments, which gave results proving the hypothesis just stated. He had vanes set at the following angles, and found it better to give an excess of retirement from, than an excess of exposure to, the wind.

No.	Angle with the axis.	Angle with the Plane of Motion.
1	.... 72°	.... 18°
2	 71	.... 19°
3	 72	.... 18° in the middle.
4	 74	.... 16°
5	.... 77½	.... 12½°
6	 83	.... 7° at the extremity.

He also tried the effects of a greater expanse of surface upon the same radius; the result was, that a broader sail, in all cases, required a larger angle; and that frustrated pyramidal sails, having their bases outwards, were more powerful than parallelograms; the extreme or outer bar being one third the depth of the whip, or vane staff. Attempts were made to fill the whole space with sails; but it was evident that, for want of sufficient passage for the wind, the intention was not fulfilled: when more than ⅞ths of the area was spread with sail, there was an immense pressure, which caused much friction and imminent danger, while the velocity was rather diminished than augmented. Length of sail is a great object, so far as relates to the acquisition of power, but where an excess prevails, many injuries are sustained; notwithstanding the boom and guys, used in many places for the support of long arms.

As water-mills are, in general, stopped by shutting out the water, and thus debarring further influence of the power at pleasure; so wind mills are commonly stopped by a pinch, or pressure, on the axis bearing the vanes. Some are likewise acted upon by a weight which tends to retard the motion, and so slackens the rotation as to enable the pinch to have more effect. We have seen instances where the great axle could be cast off in an instant; so that, although the vanes might continue to go round, the interior movements were stopped. This is an excellent contrivance, and may often save a mill from being burnt, when by accident, or neglect, the stones have come in contact and produced collisive sparks. But in such case, it is obvious that a sufficient counter-check should be created to retard the motion of the vanes; else they would, from want of due opposition, move round with great rapidity, and produce other dangers no less imminent. This prevention is easily effected by causing the lever, which raises the main axle, to act against a stiff-set wheel, capable of checking its progress.

Some mills have a weathercock placed in the line with the axis, projecting several feet, and having sufficient surface to cause the cap to move round, so as always to keep the butt of the axle direct to the wind. This is an admirable expedient, inasmuch as it effectually answers the intention, and supersedes the necessity for the miller's constant attention to the wind; which, when variable, occasions considerable interruption to other avocations, and may, eventually, be attended both with loss of time and some damage.

Mr. John Bywater, of Nottingham, obtained a patent for clothing, or unclothing, the sails of wind-mills while in motion: his

contrivance was nothing more than causing them to roll up lengthwise, by means of small wheels, or ratchets, placed near the axis, and acted upon by it in its revolution.

Mills, *horizontal wind*, have likewise been tried, but they are both troublesome to manage and deficient in power: on the other hand, they are far safer, and cheaper in their construction than the vertical kind. The simplest mode of constructing a windmill is with a spiral sail, passing round a centre pole, tapering towards the summit, and spreading to a great width at the base. This certainly has not very great powers, but acts with great uniformity, and requires no attendance, since it matters not from what quarter the wind blows. We consider this machine to be very well calculated for raising water from fens, &c. both on account of its cheapness and its safety, even in the most exposed situations. The pole, or axis, to which the sail is fastened all the way up, being perpendicular, and every part presented to the wind giving it a tendency to rotation, while the main part being below, insures a steady action, and that absence of violent friction which cannot be effected in a vertical mill, or in any machine where the greater part of the power is derived from the extremities of long arms, or vanes. See Windmill.

Mills, *horse* and *hand*, are usually upon a small construction, rarely calculated to produce any considerable effect, and more appropriate to domestic purposes of inferior consideration. These machines, as their names imply, derive their action from animal force, which is unquestionably the dearest, most irregular, and least efficient, of all the powers hitherto applied to mechanism. In horse-mills, one, two, or more horses, or other cattle, are made either to draw, or push before them, levers, which project from a centre shaft, bearing the great horizontal wheel that gives motion to the more remote parts, and which act with more or less effect, according to the length of the levers, and the number of cattle employed. For threshing, drawing water, grinding, polishing, &c. such a power answers as a substitute where water is not at command. But, owing to the inequality of pace, and to the great propensity all animals have to lean towards the centre (in lieu of moving with freedom along the given circle of perambulation), all machines worked by cattle invariably become speedily deranged, and are encumbered with an excess of friction. Hand-mills labour under a similar inconvenience; though such as are regulated by fly-wheels, which occasion a great accumulation of force, and at the same time dispose to a degree of regularity in its action, are both more efficient and more durable. Of these we have numbers, such as chaff-cutting machines, grind-stones, &c; indeed, the mangle may be included among this class. In several countries the whole of the flour, meal, &c. used by the natives, are produced by means of hand-mills; our legislature, however, considering these as drawbacks on the livelihood of a very numerous class, has prohibited their use, under very heavy penalties. In many parts of Scotland the tenants are generally thirled, *i. e.* invariably obliged to send whatever corn they wish to grind to some particular mill; any deviation is actionable. This was at one time, perhaps, necessary, for the encouragement of millers, when they first introduced water machinery into that kingdom; at present it operates not only as an inconvenience, but, in many instances, as a hardship, amounting nearly to a prohibition. The evil, however, sometimes carries its own remedy, for the tenants sell their corn to the owner of some other neighbouring mill; and, when it is ground, buy the flour it produced: thus they evade the thirling, which binds only to the grinding of what they do not dispose of.

Mills, *bark*, are most frequently worked by cattle, and perform their office by means either of large beams called beetles, which being lifted in successive order fall into cavities wherein the bark, previously dressed in a proper manner, is placed, and pounds it to a sufficient degree of fineness to answer the tanner's purpose. Madder, and many other articles used in various trades, are also broken in the same manner. Paper is made from rags, which being dusted in sieves, &c. and soaked, are macerated in a mill, which tears the several fibres apart, and reduces the whole to a fine pulp.

Mills, *coffee* and *pepper*, are too well known to require detail; we were not a little surprised to find the ordinary machinery of this class, when extended to a very large scale, obtain a patent for the grinding of bark.

Mills, *oil*, are very simple in their construction; they being nearly the same as cyder mills, consisting of troughs wherein the seed is broken by the passage of immense cylinders, or cones, of iron or stone, and afterwards put into presses for the purpose of forcing the oil from the residuum,

which is sold, under the name of oil-cake, for the purpose of fatting cattle.

MILLS, *copper* and *brass*, are almost invariably worked by water, having large wheels that give immediate action to hammers of great weight, some being near three hundred weight; these beat out the large slabs and bricks of metal into various forms, such as kettles, coppers, boilers, &c. and roll out sheets for various purposes, but especially for coppering the bottoms of ships. This process is effected by passing the heated metal between two cast iron cylinders, of about a foot diameter, which, having contrary motions, draw it through a small interval left between them; and, by reducing the thickness, give greater surface to the sheet. In this manner the metal may be brought to any degree of thinness; the workmen bringing the cylinders nearer to each other, by means of screws at each end, every time a plate has been passed. The same mills have shears, worked by offsets from the counter-wheels, that cut the edges of the plates perfectly even, and are sufficiently forcible to divide lumps of copper, full an inch thick and six or seven in breadth, at one cut, the metal being previously brought to a red heat.

MILLS, *silk*, *cotton*, &c. require much delicacy in their construction; their principal movements depend on the same principles as those of the mills described in the plate; the more minute parts, such as the bobbins, &c. being moved by means of one or more leather straps passing them, in close contact, so as to occasion them to revolve with an astonishing degree of velocity.

MILLS, *saw*, though extremely simple in their parts, require the greatest care in their formation. The saws which are moved by cranks (much the same as those in use for pumps in water-works), must be set with most scrupulous exactness, else they will not only tear obliquely, and destroy much wood, but create such an accumulation of friction as must deteriorate the powers of the machine so as to approach to equilibrium. In most instances the timber is brought forward to the saw by means of a small toothed wheel, and an axle whereon the rope that pulls the timber is gradually coiled. See SAW-MILL.

MILLS, *flax*, are generally worked by cattle; their construction is simple; the essential parts being the hackle, which combs the flax; and the scutcher, which strikes it: both tend to clearing away the coarser and unequal fibres, and to prepare the material for being spun either by hand, or by means of machinery.

We feel some surprise at the neglect shewn towards a very ingenious and useful invention in the department of mill-work; viz. the action of wheels, mutually, without the aid of cogs, or teeth. We have instances of wheels having been worked for nearly 30 years, simply by means of contact; the fellies (or circumference), being made of pieces of wood, having their grain, or fibres, all pointing to the centre. This produces a certain degree of roughness, exteriorly, which causes two wheels, thus formed, to bind sufficiently for the purposes of communicating rotation, where the stress is not excessive; and, even in that case, much may be effected by causing the wheels to bear very hard against each other, so as to excite friction to such an extent as may overcome the resistance of the weight, &c. We have seen a spinning machine consisting only of a vertical wheel (turned by a foot-lathe), that had its perimeter armed with a band of stout buff-leather; which coming in contact with a number of bobbins, &c. caused all to move with great rapidity. Each bobbin was under the care of a little girl, who, by means of a slider, could either set it to work by approximation to the wheel, or liberate it from agency by withdrawing it from contact.

Having said thus much on the subject of mill-work, we beg leave to refer those of our readers who may be in search of abstruse knowledge, to Olinthus Gregory's work on the Theory of Mechanics; and to the excellent practical treatise of the late Mr. Smeaton, for a great variety of experiments not only in this, but in many other most important branches of mechanics; which the limits of our volumes do not permit us to enter upon in any other than a brief, summary, and popular manner.

MILL. From and after July 1, 1796, every miller shall have in his mill a true balance, with proper weights; and every miller, in whose mill shall be found no balance or weights, shall forfeit not exceeding 20*s*.

Every person may require the miller to weigh, in his presence, the corn before it shall be ground, also after it shall be ground; and if he refuse, he shall forfeit not exceeding 40*s*. Every miller shall, if required, deliver the whole produce of the corn, allowing for the waste in grinding and toll, when toll is hereinafter allowed to be taken, on pain to forfeit not exceeding 1*s*. per bushel, and

treble the value of the deficiency. Where toll is allowed to be taken it shall be deducted before the corn is put into the mill. From and after June 1, 1796, no miller shall, under the penalty of 5*l.* take any part of the corn, or of the produce, for toll; but in lieu thereof he shall be entitled to demand payment in money. But where the party shall not have money to pay for grinding, the miller, with his consent, may take such part of the corn as will be equal to the money price, expressed in their table of prices for grinding. Also nothing in this clause shall extend to the ancient mills called soke-mills, or such others where the possessors are bound to grind for particular persons, or within particular districts, and to take a fixed toll.

From and after June 1, 1796, every miller shall put up in his mill a table of the prices, or of the amount of toll at his mill, on pain of forfeiting not exceeding 20*s.*

MILLEPES, the common *wood louse*, a species of the oniscus with a blunt forked tail. See ONISCUS.

MILLEPORA, in natural history, a genus of insects of the Vermes Zoophyta class and order. Animal an hydra or polype; coral, mostly branched and covered with many cylindrical turbinated pores; hence its name, a thousand pores. There are more than thirty species, of which we shall notice M. miniacea, very minute, branching into small lobes, and covered with very small pores. This is an inhabitant of the Mediterranean and Indian Seas; is a beautiful little coral, and the smallest of the genus, being seldom more than a quarter of an inch high; the whole surface when magnified appears full of white blind pores, and on the tops of the lobes are several scattered holes surrounded with a margin; the base is broad, by which it adheres to shells, corals, and rocks. M. cervicornis; a little compressed, dechotomous, with cells on both sides, and tubular, somewhat prominent florets. It is found in the Mediterranean and on the Cornish coast five or six inches high; reddish or yellowish brown, branched like the horns of a stag, and appearing as if covered with varnish. M. polymorpha; crustaceous, solid, irregularly shaped, but generally branched and tuberculate, and without visible pores; inhabits most European seas, and is the common coral of the shops; in many places it grows in such abundance that it is burnt for manure: its colour is either red, yellowish, green, and sometimes white. It is frequently shaped like a walnut, often in large compressed masses, sometimes like a small bunch of grapes, but most frequently in short irregular ramifications of a chalky tuberculate appearance and stony substance.

MILLERIA, in botany, so named in honour of Philip Miller, author of the Gardeners' Dictionary and Calendar; a genus of the Syngenesia Polygamia Necessaria class and order. Natural order of Compositæ Oppositifoliæ. Corymbiferæ, Jussieu. Essential character: calyx, three valved; ray of the corolla halved; down none; receptacle naked. There are three species; of which M. biflora, two flowered milleria, is an annual plant, rising with an herbaceous stalk upwards of two feet high, branching out at a small distance from the root into three or four slender stalks, which are almost naked to the top, where they have two lanceolate leaves placed opposite, nearly two inches long; they have three longitudinal veins, and are slightly indented on their edges; the flowers come out at the foot stalks of the leaves, in small clusters; the common calyx is composed of three orbicular leaves, compressed together; in each of these are two imperfect hermaphrodite florets, which are barren; and one female ligulate fruitful floret, to which succeeds a roundish angular seed, inclosed in the calyx. This plant was discovered at Campeachy, by Dr. Houston.

MILLET. See MILIUM.

MILLING, in the manufacture of cloth, the same with fulling. See FULLING.

MILLION, in arithmetic, the number of ten hundred thousand, or a thousand times a thousand.

MILLREE, a Portuguese gold coin, equal to 5*s.* 7½*d.* of our money.

MIMOSA, in botany, a genus of the Polygamia Monoecia class and order. Natural order of Lomentaceæ; Leguminosæ, Jussieu. Essential character: hermaphrodite, calyx, five-toothed; corolla five-cleft; stamina five or more; pistillum one; legume: male, calyx, five-toothed; corolla five-cleft; stamina five, ten, or more. There are eighty-five species; among which the M. sensitiva, sensitive plant, rises with a slender woody stalk seven or eight feet in height, armed with short recurved thorns; the leaves grow upon long foot stalks, which are prickly, each sustaining two pair of wings; from the place where these are inserted, come out small branches, having three or four globular heads of pale pur-

plish flowers coming out from the side, on short peduncles; the principal stalk has many of those heads of flowers on the upper part, for more than a foot in length; this, as also the branches, is terminated by like heads of flowers; the leaves move but slowly when touched, but the foot-stalks fall, when they are pressed pretty hard. It is a native of Brasil. M. pudica, humble plant, has the roots composed of many hairy fibres, which mat closely together; from these come out several woody stalks, declining towards the ground, unless supported, they are armed with short recurved spines, having winged or pinnate leaves; flowers from the axils, on short peduncles, collected in small globular heads, of a yellow colour. "Naturalists," says Dr. Darwin, "have not explained the immediate cause of the collapsing of the sensitive plant; the leaves meet and close in the night during the sleep of the plant, or when exposed to much cold in the day-time, in the same manner as when they are affected by external violence, folding their upper surfaces together, and in part over each other like scales or tiles, so as to expose as little of the upper surface as may be to the air; but do not, indeed, collapse quite so far; for when touched in the night during their sleep, they fall still farther; especially when touched on the foot-stalks between the stems and the leaflets, which seems to be their most sensitive or irritable part. Now as their situation after being exposed to external violence resembles their sleep, but with a greater degree of collapse, may it not be owing to a numbness or paralysis consequent to too violent irritation, like the faintings of animals from pain or fatigue? A sensitive plant being kept in a dark room till some hours after day break, its leaves and leaf-stalks were collapsed as in its most profound sleep, and on exposing it to the light, above twenty minutes passed before the plant was thoroughly awake, and had quite expanded itself. During the night the upper surfaces of the leaves are oppressed; this would seem to show that the office of this surface of the leaf was to expose the fluids of the plant to the light as well as to the air." Dr. Darwin has thus characterized these plants.

"Weak with nice sense, the chaste Mimosa stands,
From each rude touch withdraws her timid hands;
Oft as light clouds o'erpass the summer glade,
Alarm'd she trembles at the moving shade;
And feels alive through all her tender form,
The whisper'd murmurs of the gathering storm;
Shuts her sweet eyelids to approaching night,
And hails with freshen'd charms the rising light."

MIMULUS, in botany, *Monkey flower*, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Scrophulariæ, Jussieu. Essential character: calyx four-toothed, prismatical; corolla, ringent; the upper lip folded back at the sides; capsule, two-celled, many seeded. There are four species, natives of North and South America.

MIMUSOPS, in botany, a genus of the Octandria Monogynia class and order. Natural order of Holoraceæ. Sapotæ, Jussieu. Essential character: calyx four-leaved; petals four; nectary sixteen-leaved; drupe acuminate. There are three species, of which M. elengi is a middle sized tree, with entire smooth leaves; flowers axillary, on many simple peduncles; calyxes tomentose; berry superior, defended at the base by the permanent calyx, having an obsolete groove on one side, shagreened all over with very minute callous dots. It is a native of the East Indies, where it is much cultivated on account of its fragrant flowers, which come out chiefly in the hot season.

MINA, in Grecian antiquity, a money of account, equal to an hundred drachms.

MIND. See Philosophy *of the Mind*.

MINE, in natural history, a place under ground, where metals, minerals, or even precious stones are dug up.

As, therefore, the matter dug out of mines is various, the mines themselves acquire various denominations, as gold-mines, silver-mines, copper-mines, iron-mines, diamond-mines, salt-mines, mines of antimony, of alum, &c.

Mines, then, in general, are veins or cavities within the earth, whose sides receding from, or approaching nearer to, each other, make them of unequal breadths in different places, sometimes forming larger spaces, which are called holes: they are filled with substances, which, whether me-

tallic or of any other nature, are called the loads; when the substances forming these loads are reducible to metal, the loads are by the miners said to be alive; otherwise they are called dead loads. In Cornwall and Devon, the loads always hold their course from eastward to westward; though in other parts of England, they frequently run from north to south. The miners report, that the sides of the load never bear in a perpendicular, but constantly underlay, either to the north or to the south. The load is frequently intercepted by the crossing of a vein of earth, or stone, or some different metallic substance; in which case it generally happens that one part of the load is moved a considerable distance to the one side. This transient load is by the miners called flooking: and the part of the load which is to be moved, is said to be heaved. According to Dr. Nichols's observations upon mines, they seem to be, or to have been, the channels through which the water pass within the earth, and, like rivers, have their small branches opening into them, in all directions. Most mines have streams of water running through them; and when they are found dry, it seems to be owing to the waters having changed their course, as being obliged to it, either because the load has stopped up the ancient passages, or that some new and more easy ones are made. Mines, says Dr. Shaw, are liable to many contingencies; being sometimes poor, sometimes soon exhaustible, sometimes subject to be drowned, especially when deep, and sometimes hard to trace; yet there are many instances of mines proving highly advantageous for hundreds of years: the mines of Potosi are to this day worked with nearly the same success as at first; the gold-mines of Cremnitz have been worked almost these thousand years; and our Cornish tin-mines are extremely ancient. The neat profit of the silver alone, dug in the Misnian silver-mines in Saxony, is still, in the space of eight years, computed at a thousand six hundred and forty-four millions, besides seventy-three tons of gold. Many mines have been discovered by accident: a torrent first laid open a rich vein of the silver-mine at Friberg in Germany; sometimes a violent wind, by blowing up trees, or overturning the parts of rocks, has discovered a mine; the same has happened by violent showers, earthquakes, thunder, the firing of woods, or even the stroke of a plough-share, or horse's hoof.

But the art of mining does not wait for these favourable accidents, but directly goes upon the search and discovery of such mineral veins, ores, or sands, as may be worth the working for metal. The principal investigation and discovery of mines depend upon a particular sagacity, or acquired habit of judging from particular signs, that metallic matters are contained in certain parts of the earth, not far below its surface. The principal signs of a latent metallic vein, seems reducible to general heads, such as, 1. The discovery of certain mineral waters. 2. The discolouration of the trees or grass of a place. 3. The finding of pieces of ore on the surface of the ground. 4. The rise of warm exhalations. 5. The finding of metallic sands, and the like. All which are so many encouragements for making a stricter search near the places where any thing of this kind appears; whence rules of practice might be formed for reducing this art to a greater certainty. But when no evident mark of a mine appears, the skilful mineralist usually bores into the earth, in such places as from some analogy of knowledge, gained by experience, or by observing the situation, course, or nature of other mines, he judges may contain metal: this method of boring we have already given under the article BORING.

After the mine is found, the next thing to be considered is whether it may be dug to advantage. In order to determine this, we are duly to weigh the nature of the place, and its situation, as to wood, water, carriage, healthiness, and the like, and compare the result with the richness of the ore, the charge of digging, stamping, washing, and smelting.

Particularly the form and situation of the spot should be well considered. A mine must either happen, 1. In a mountain. 2. In a hill. 3. In a valley. Or, 4. in a flat. But mountains and hills are dug with much greater ease and convenience, chiefly because the drains and burrows, that is, the adits or avenues, may be here readily cut, both to drain the water and to form gangways for bringing out the lead, &c. In all the four cases we are to look out for the veins which the rains, or other accidental thing, may have laid bare; and if such a vein be found, it may often be proper to open the mine at that place, especially if the vein prove tolerably large and rich: otherwise the most commodious place for situation is to be chosen for the

purpose, viz. neither on a flat, nor on the tops of mountains, but on the sides. The best situation for a mine, is a mountainous, woody, wholesome spot; of a safe easy ascent, and bordering on a navigable river. The places abounding with mines are generally healthy, as standing high, and every where exposed to the air; yet some places, where mines are found, prove poisonous, and can, upon no account, be dug, though ever so rich: the way of examining a suspected place of this kind, is to make experiments upon brutes, by exposing them to the effluvia or exhalations to find the effects.

MINE, in fortification, &c. is a subterraneous canal or passage, dug under any place or work intended to be blown up by gunpowder. The passage of a mine leading to the powder is called the gallery; and the extremity, or place where the powder is placed, is called the chamber. The line drawn from the centre of the chamber perpendicular to the nearest surface, is called the line of least resistance; and the pit or hole, made by the mine when sprung or blown up, is called the excavation. The mines made by the besiegers in the attack of a place, are called simply mines; and those made by the besieged, countermines. The fire is conveyed to the mine by a pipe or hose, made of coarse cloth, of about an inch and half in diameter, called saucisson, extending from the powder in the chamber to the beginning or entrance of the gallery, to the end of which is fixed a match, that the miner who sets fire to it may have time to retire before it reaches the chamber. It is found by experiments, that the figure of the excavation made by the explosion of the powder, is nearly a paraboloid, having its focus in the centre of the powder, and its axis the line of least resistance: its diameter being more or less according to the quantity of the powder, to the same axis, or line of least resistance.

MINERAL *waters*. See WATERS, *mineral*.

MINERALIZER, a name to any substance found in natural combination with a metal; thus lead is said to be mineralized by sulphur, when combined with it in the native sulphuret.

MINERALOGY, that science which teaches us the properties of mineral bodies, and by which we learn how to characterise, distinguish, and class them into a proper order. Mineralogy seems to have been in a manner coeval with the world. Precious stones of various kinds appear to have been well known among the Jews and Egyptians in the time of Moses; and even the most rude and barbarous niatons appear to have had some knowledge of the ores of different metals. As the science is nearly allied to chemistry, it is probable that the improvements, both in chemistry and mineralogy, have nearly kept pace with each other; and indeed it is but of late, since the principles of chemistry were well understood, that mineralogy has been advanced to any degree of perfection. The best way of studying mineralogy, therefore, is by applying chemistry to it; and not contenting ourselves merely with inspecting the outsides of bodies, but decomposing them, according to the rules of chemistry. This method has been brought to the greatest perfection by M. Pott of Berlin, and after him by Mr. Cronstedt of Sweden. To obtain this end, chemical experiments in the large way are, without doubt, necessary; but as great tracts of the mineral kingdom have been examined in this manner by different writers, the curious mineralogist need not repeat those experiments in their whole extent. An easy way may be adopted, which even for the most part is sufficient, and the processes of which, though made in miniature, are as scientifical as the common manner of proceeding in the laboratories, since it imitates that, and is also founded upon the same principles. This method consists in making the experiments upon a piece of charcoal, with the concentrated flame of a candle directed through a blow pipe. The heat occasioned by this is very intense, more especially if a stream of oxygen gas be thrown upon the subject under examination; and the different mineral bodies may thus be burnt, calcined, melted, and scorified, &c. as well as in any great furnace. When earths or stones are to be tried, it is improper to begin immediately with the blow-pipe: some preliminary experiments ought to be made, by which those in the fire may afterwards be directed. For instance, a stone is not always homogeneous, or of the same kind throughout, although it may appear to the eye to be so. A magnifying glass is therefore necessary to discover the heterogeneous particles, if there be any; and these ought to be separated, and every part tried by itself, that the effects of two different things, examined together, may not be attributed to one alone. This might happen with some of the finer micæ, which are now and then

found mixed with small particles of quartz, scarcely to be perceived by the eye. The trapp is also sometimes mixed with very fine particles of feltspar, or of calcareous spar, &c. After this experiment, the hardness of the stone in question must be tried with steel. The flint and garnets are commonly known to strike fire with steel; but there are also other stones, which, though very seldom, are found so hard as likewise to strike fire. There is a kind of trapp of that hardness, in which no particles of feltspar are to be seen. Coloured glasses resemble true gems; but as they are very soft in proportion to these, they are easily discovered by means of the file. The common quartz-crystals are harder than coloured glasses, but softer than the gems. The loadstone discovers the presence of iron, when it is not mixed in too small a quantity in the stone, and often before the stone is roasted. Some kinds of hæmatites, and particularly the cerulean, greatly resemble some other iron ores; but this distinguishes itself from them by a red colour when pounded, the others giving a blackish powder, and so forth.

In a work of this magnitude we cannot enter much at large into historical details; it may, however, be proper to notice in brief the principal different systems that have been given to the world.

The system of Cronstedt was published in 1758, and for twenty years was generally received by the scientific world. In 1780, a translation of Cronstedt's mineral system appeared in Germany, accompanied with notes, by Werner, the Professor of Mineralogy at Freyberg in Saxony. Six years before, the professor had published a separate treatise on the classification of minerals, in which he exhibited much skill in a method of describing them by means of external characters. Werner's method is chiefly, if not wholly, followed in Germany, and is highly regarded in this and other countries. This system was introduced here by Mr. Kirwan, in 1781, who further elucidated it some years afterwards by a new and much enlarged edition of his work. In preparing the latter edition, Mr. Kirwan had the advantage of consulting one of the completest and best arranged collections of minerals which had been made in any country. This was collected by Leske, and after him is called the Leskean collection. It was arranged between the years 1782 1787, according to the principles of Werner, and with his assistance. After the death of Leske, a catalogue of it was drawn up, which is divided into five parts: the first, which is denominated the characteristic parts, consists of specimens intended for the illustration of the external characters of the classification. The second, which is the systematic or oryctognostic part, comprehends all simple minerals distributed according to their genera and species, agreeably to the method at that time followed by Werner. The next is the geognostic geological part, which includes the substances found in the different kinds of rocks, as they are divided into primitive, transition, stratiform, alluvial, and volcanic mountain. This part of the collection is very rich in petrifactions. The fourth part is intended to illustrate the mineralogy of every country on the globe, by exhibiting its mineral productions. The fifth part is called the economical collection, and is formed of specimens which are employed in arts and manufactures, as in architecture, sculpture, agriculture, jewelry, dying, clothing, pottery, glazing, enamelling, polishing of metals, furnace-building, medicine, metallurgy, &c. This short account of a very valuable collection may be a guide to collectors and amateurs in the science. In France, the mineralogical treatises of Brochant, Hauy, and Brongniart may be noticed; these have already been referred to in the course of our volumes, but claim a distinct enumeration here. The system of Brochant is formed on the principles of Werner's classification, and is thought to be the most perspicuous account of the German mineralogy that has yet been published. The system of Hauy divides itself into four classes. The first class consists of substances which are composed of an acid united to an earth and alkali, and sometimes to both. The second class includes only earth substances, but sometimes combined with an alkali: it constitutes the siliceous genus of other systems. The third class comprehends combustible substances which are not metals. The metals form the fourth class. This is divided into three orders, which are characterized by different degrees of oxydation. Besides these classes, there are three appendices. The first contains these substances, the nature of which is not sufficiently known to have their places accurately assigned in the system. The second appendix includes aggregates of different mineral substances: and the third is devoted to the consideration of volcanic products.

The system of Brongniart includes substances which are not treated of by writers on mineralogy, and is divided into five classes. The first contains those substances, excluding the metals, which are combined with oxygen; it contains two orders: the first including air and water; and the second the acids. The second class treats of saline bodies, and comprehends the alkaline and the earthy salts. The third class, containing stones, includes the hard, the magnesian, and the argillaceous stones. The fourth class contains the combustible substances, viz. the compound and simple. The fifth class includes metals, which are separated into the brittle and the ductile.

The system of Werner, as given by Professor Jameson, has been chiefly adhered to in this work, and a detail of the several genera will be found in their alphabetical order; it will therefore be sufficient, in this place, to give an outline of his system.

He has arranged the characters of minerals under four divisions: the external; the internal or chemical; the physical; and the empirical. To the first belong the characters drawn from those properties which are obvious to the senses, such as colour, lustre, transparency, form, texture, hardness, and specific gravity: to the second, those which are derived from the chemical composition, or discovered by any chemical change which the mineral suffers: to the third are referred those characters which are afforded by certain physical properties, as electricity or magnetism; and to the fourth, a few characters derived from circumstances frequently observed with regard to a mineral, as the place where it is found, or the minerals by which it is usually accompanied.

Of these divisions, the external characters are considered as the most important, and it is chiefly with regard to them that so much labour has been employed on the language of mineralogy. The first property is colour, which, though but seldom highly characteristic, is one of the most obvious characters. It varies frequently in the same species, and is liable to change by very trivial foreign circumstances; it always enters, however, into the description. To give precise ideas of the different shades of colour, Werner has fixed on certain principal or standard colours, to which the subordinate shades are referred; defining them by means of an epithet, either expressive of the intermixture of one of the principal colours with the other, or derived from some substance familiarly known, the colour of which is constant. The principal characters are white, grey, black, blue, green, yellow, red, and brown. Of these are numerous subordinate colours, as blueish-grey, greyish-black, &c. These are not always well marked, but incline to, are intermediate, or pass into each other. The shade of colour is of different intensities, as dark, deep, light, and pale. Besides these, other varieties are introduced, as dotted, striped, zoned, &c. and the colour is varied by scraping the surface, affording a character called a streak.

Lustre denotes the relation which a fossil bears to the reflection of the light from its surface. According to Werner, "resplendent" denotes the highest degree of lustre, which is such as to be seen at a considerable distance; "shining" is applied when the lustre, though perceived at a distance, is not so well observed as on a near approach; "glistening," when it is perceptible only at a very short distance; "glimmering," when some of the minute parts only of a surface reflect a weak light; and "dull," when lustre is entirely wanting. Different kinds of lustre are also marked, as the metallic, adamantine, vitreous, waxy, pearly, and resinous.

Transparency is denoted by different degrees and terms; "transparent" is applied where objects can be distinctly perceived through the interposed substance; "semitransparent," where objects are seen, but not distinctly, and this only through thin pieces; "translucent," when light is in some measure transmitted, but objects cannot be observed; "opaque," when no perceptible light is transmitted; connected with transparency is refraction, which, in the greater number of minerals, is single, but in some double, the latter giving a double image when an object is surveyed through them.

Form, the most important, perhaps, of the external characters, includes the figures of their crystals, and the various particular shapes which many of them, even in their uncrystallized state, often assume. The texture of fossils, as discovered by their fracture, affords another and very important discriminating character. The fracture may either present a surface continuous or uninterrupted; or it may present a surface composed of an aggregation of distinct parts, by which the continuity is more or less broken. The former is denominated

the compact, the latter has been termed the jointed fracture; and each is subdivided into a number of varieties. Minerals are likewise discriminated by their hardness. The degree of it in a fossil is judged of with most certainty by the comparative facility or difficulty of impressing it. Four degrees of it are marked by Werner; the "hard," in which the substance is not capable of being scratched by the knife, but gives sparks when struck by the steel: "semi-hard," when it does not strike fire with steel, and may be scraped by the knife; "soft," when it may be easily scraped with the knife, but receives no impression from the nail; and "very soft," when it is scratched by the nail.

Hauy determines the degrees of hardness according as one fossil impresses another. In one division, those are placed which scratch quartz; the individuals belonging to this are arranged as much as possible in the order of their relative hardness, so that when placed in a column, each will impress those beneath it. The second class are those which will scratch glass: these are arranged in a similar manner. In a third, those which scratch calcareous spar: and in a fourth, those which make no impression upon it.

Tenacity is that property which relates to the cohesion of the integrant particles of solid minerals, which, existing in different degrees, gives rise to the distinctions of brittle, malleable, and the intermediate degree of sectile.

The frangibility denotes the facility with which a mineral may be broken. It exists in different degrees, which are marked by the common terms of difficulty frangible, easily frangible, &c. According to the Wernerian system, the specific gravity is thus described: a mineral is said to be "supernatant," which is lighter than water, and will swim upon its surface: it is called "light," when the specific gravity is between 1.0 and 2.0: "rather heavy," when the specific gravity is between 2.0 and 4.0: "heavy," where it varies from 4.0 to 6.0: and "very heavy," when the specific gravity is above 6.0. The better way is that which we have adopted under the several genera, of stating the numbers denoting the real specific gravity, as found by the hydrostatic balance. To these external characters are added others of less importance, which are derived from properties peculiar to a few minerals, such as that of adhering to the tongue, soiling the finger, feeling hard or unctuous, giving a particular streak on paper, giving when struck a peculiar sound, feeling cold when applied to the tongue, having taste, or emitting some perceptible odour.

With respect to the chemical characters: "fusibility" is generally determined by the action of the blow-pipe, as we can thus operate on a small fragment, and perceive easily the appearances presented on fusion. Some minerals are perfectly infusible by it; others melt with facility, some fuse with intumescence; others decrepitate or exfoliate when urged by the flame, or lose their colour; in some the fusion is partial; sometimes the result is a kind of scoria, in many cases it is a complete vitreous globule, transparent or opaque, and of various colours. These appearances are diversified, by adding to the substances various fluxes, as borax, and the phosphates of soda and ammonia. The action of acids affords another chemical character of fossils, by observing whether they effervesce when touched with the acid, or whether, when a small fragment is immersed in it, it is partially or entirely dissolved: if the solution is fluid or gelatinous; and what appearances it presents from the action of re-agents. Diluted nitric acid is generally used in these trials. To the characters taken from certain physical properties are referred the phosphorescence, electricity, and magnetism of minerals. Phosphorescence is peculiar to some minerals, and is therefore a property well adapted to assist in their discrimination. In some it is excited by attrition, more or less strong; in others, by exposing them to heat. The electrical state, either positive or negative, is excited in some minerals by friction in others by heat: and iron, in many states of combination, is discovered by its magnetic power. An advantage is sometimes taken of what are denominated empirical characters; of these the most important is that derived from the natural association of minerals: some being found in the same situation, and even blended with each other; while there are others which have never been observed to occur together.

MINES. Gold and silver mines belong to the king by his prerogative. By statute 1 and 5 William, c. 30, and 6, no mine of copper, tin, iron, or lead shall be deemed a royal mine, notwithstanding gold or silver may be extracted from them in any quantities. But the king may take the ore at a certain rate, except in Devon and Cornwall. Maliciously to set fire to a mine or

pit of coal is felony, without benefit of clergy. If there is a lease of land, with open mines, the lessee may work them, but not to open new ones. If the lease is of land and mines, and none are opened, the words necessarily imply a right to open mines. If a man open a mine, he may follow the vein under the land of another; but if the latter opens a pit on his own land, the former cannot pursue the vein.

MINIATURE, a delicate kind of painting, distinguished from all others by the smallness of the figures, its being performed with dots or points, instead of lines; by the faintness of the colouring; its requiring to be viewed very near; and by its being usually done on vellum. See PAINTING.

MINIMUM, in the higher geometry, the least quantity attainable in a given case. See MAXIMUM.

MINING, in military affairs, is the art of blowing up any part of a fortification, building, &c. by gunpowder. The art of mining requires a perfect knowledge both of fortification and geometry; and by these previous helps the engineer may be qualified to ascertain correctly the nature of all manner of heights, depths, breadths, and thicknesses; to judge perfectly of slopes and perpendiculars, whether they be such as are parallel to the horizon, or such as are visual; together with the true levels of all kinds of earth. To which must be added a consummate skill in the quality of rocks, earths, masonry, and sands; the whole accompanied with a thorough knowledge of the strength of all sorts of gunpowder. Mining is become one of the most essential parts of the attack and defence of places: so much artillery is used, that nothing above ground can withstand its effects; the most substantial ramparts and parapets can resist but a short time; the out-works, though numerous, serve only to retard, for a time, the surrender of the place.

MINISTER, a person who preaches, performs religious worship in public, administers the sacraments, &c.

MINISTER *of state*, a person to whom a sovereign prince intrusts the administration of the government.

MINISTER, *foreign*, is a person sent into a foreign country to manage the affairs of his province, or of the state to which he belongs. Of these there are two kinds: those of the first rank are embassadors and envoys extraordinary, who represent the persons of their sovereigns. The ministers of the second rank are the ordinary residents.

MINIUM, in the arts, red lead and oxide of lead. See LEAD.

MINSTREL, in ancient customs, certain persons who combined the character of poet and musician, and whose profession it was to wander about the countries they inhabited, singing panegyrical songs and verses on their occasional benefactors, accompanying them with some musical instrument.

MINT, the place in which the king's money is coined. See COINING.

There were anciently mints in almost every county in England; but the only mint at present in the British dominions is that in the Tower of London. The officers of the mint are, 1. The warden of the mint, who is chief; he oversees the other officers, and receives the bullion. 2. The master-worker, who receives the bullion from the warden, causes it to be melted, delivers it to the moneyers, and when it is coined receives it again. 3. The comptroller, who is the overseer of all the inferior officers, and sees that all the money is made to the just assize. 4. The assay-master, who weighs the gold and silver, and sees that it is according to the standard. 5. The auditor, who takes the accounts. 6. The surveyor of the melting, who, after the assay-master has made trial of the bullion, sees that it is cast out, and not altered after it is delivered to the melter. 7. The engraver, who engraves the stamps and dyes for the coinage of the money. 8. The clerk of the irons, who sees that the irons are clean and fit to work with. 9. The melter, who melts the bullion before it is coined. 10. The provost of the mint, who provides for and oversees all the moneyers. 11. The blanchers, who anneal and cleanse the money. 12. The moneyers, some of whom forge the money, some shear it, some round and mill it, and some stamp or coin it. 13. The porters, who keep the gate of the mint.

MINUARTIA, in botany, so named from Minuartus, restorer of botany in Spain; a genus of the Triandria Trigynia class and order. Natural order of Caryophyllei. Essential character: calyx five-leaved; corolla none; capsule one-celled, three valved. There are three species: these are all annual plants, natives of Spain: leaves opposite, clustered; flowers in clusters, having five, or three very small petals like glands.

MINUET, in music, a movement of three crotchets or three quavers in a bar, of a slow and graceful motion, and always

beginning with the beating note. This is dancing the minuet; but there are others of a time somewhat quicker, and which were formerly used as concluding movements of overtures, sonatas, &c.

MINUTE, in geometry, the sixtieth part of a degree of a circle. Minutes are denoted by one acute accent, thus (′); as the second, or sixtieth part of a minute, is by two such accents, thus (″); and the third by three (‴), &c.

MINUTE, in architecture, usually denotes the sixtieth, sometimes the thirtieth part of a module.

MINUTE is also used for a short memoir or sketch of a thing taken in writing.

MIRABILIS, in botany, *marvel of Peru*, a genus of the Pentandria Monogynia class and order. Natural order of Nyctagines, Jussieu. Essential character: calyx inferior; corolla funnel-form, superior; nectary globular, inclosing the germ. There are four species, having tuberous roots and herbaceous stems, which are round and often trichotomous; leaves opposite; flowers terminating in a sort of corymb; outer calyx bell-shaped, spreading; inner large, petaloid, funnel-form, ventricose at the base, dilated above with a spreading border; germ half covered with an ambient gland; stamens inserted into the gland, and glued to the calycine tube; seed globular, covered with the coriaceous base of the inner calyx. This genus is allied to the Amaranthi and Caryophyllei by its farinaceous seed; to the Dipsaceæ in its habit and double calyx; it differs, however, in many marks, and it is difficult to assign it a place; hence Linnæus left it among the plants of doubtful rank, in his "Ordines Naturales."

MIRACLE, is defined by Dr. Samuel Clark to be a work effected in a manner different from the common and regular method of Providence, by the interposition either of God himself, or some intelligent agent superior to man. It has been much controverted, whether true miracles can be worked by any less power than the immediate power of God; and whether, to complete the evidence of a miracle, the nature of the doctrine pretended to be proved by it, is necessary to be taken into the consideration. The above learned author undertakes to set this matter in a clear light, as follows.

In respect to the power of God, and the nature of the things themselves, all things that are possible at all, are equally easy to be done: it is at least as great an act of power to cause the sun to move at all, as to cause it at any time to stand still; yet this latter we call a miracle, the former not. What degrees of power God may reasonably be supposed to have communicated to created beings, or subordinate intelligences, is impossible for us to determine: therefore a miracle is not rightly defined to be such an effect as could not have been produced by any less power than the divine omnipotence. There is no instance of any miracle in Scripture, which, to an ordinary spectator, would necessarily imply the immediate operation of original, absolute, and underived power. All things that are done in the world, are done either immediately by God himself, or by created intelligent beings, matter not being at all capable of any laws or powers whatsoever; so that all those things which we say are the effects of the natural powers of matter and laws of motion, are properly the effects of God acting upon matter continually and every moment, either immediately by himself, or mediately by some created intelligent beings. Consequently it is no more against the course of nature for an angel to keep a man from sinking in the water, than for a man to hold a stone from falling in the air, by overpowering the law of gravitation; and yet the one is a miracle, the other not so.

Mr. Hugh Farmer, who has entered more fully and more successfully into this subject than any other writer, objects to all the definitions of miracles which represent them as effects unusual, above human power, and manifesting the interposition of superior power; because, he says, the term unusual does not distinguish real miracles from many things which are not miraculous, such as the rare and uncommon appearances of nature: nor does the calling a miracle an effect above human power, distinguish it from all other effects equally above human power, produced by superior beings, when acting within their usual sphere, which, for that reason, cannot be miraculous. Besides, as this definition comprehends many things which are not miraculous, and to which no persons apply the term, so it excludes many things which are allowed by all to be proper miracles. For there seems to be a difference between effects above human power, or which argue a higher degree of power; and effects which argue a power barely different from human, and in no manner superior to it. According to this definition, beasts and birds may work miracles; for they do many things that are

above the power of man. Moreover, this definition, instead of describing miracles by the nature of the works themselves, describes them by their author, and the degree of power necessary to their performance. To which it may be added, that works which argue only a power more than human, can be no absolute proofs of a divine interposition: and further, the last part of the definition, manifesting the interposition of superior power, is superfluous; because it is only saying, effects above human power must be produced by a power above it.

This writer considers the contrariety or conformity of the event itself to those laws by which the world is governed in the course of God's general providence, as the only circumstance which denominates and constitutes it a proper miracle or not; and, therefore, before we can pronounce with certainty any effect to be a true miracle, it is necessary (and nothing more is necessary than) that the common course of nature be in some degree first understood. Miracles, in this view, are not impossible to the power of God, nor necessarily repugnant to our ideas of his wisdom and immutability. Neither do they imply any inconsistency in the divine conduct, or a defect or disturbance of the laws of nature: so that in the general idea of miracles, considered as variations from the common course of nature, there is nothing that can furnish a certain universal proof against their existence; and there is a power superior to nature, which is ever able, and which, in certain circumstances, may reasonably over-rule what was at first established.

The writer, now cited, further maintains, that miracles are neither the effects of natural causes, nor of superior created intelligences acting from themselves alone; but that they are always to be ascribed to a divine interposition; *i. e.* that they are never wrought, but either immediately by God himself, or by such other beings as he commissions and empowers to perform them. In proof of this proposition, he alleges, that the same arguments which prove the existence of superior created intelligences, do much more strongly conclude against their acting out of their proper sphere. Further, the supposition of the power of any created agents to work miracles of themselves in this lower world, is contradicted by the observation and experience of all ages; there being, in fact, no proper evidence of the truth of any miracles, but such as may be fitly ascribed to the Deity. Moreover, the laws of nature being ordained by God, and essential to the order and happiness of the world, it is impossible God should delegate to any of his creatures a power of working miracles, by which those divine establishments may be superseded and controlled. Besides, the ascribing to any superior beings, God excepted, and those immediately commissioned by him, the power of working miracles, subverts the foundation of natural piety, and is a fruitful source of idolatry and superstition.

It is further urged, that if miracles were performed in favour of false doctrines, mankind would be exposed to frequent and unavoidable delusion: and if they may be performed without a divine permission, and in support of falshood, they cannot be credentials of a divine mission, and criterious of truth. So that, upon the whole, if superior beings really possess the miraculous powers which some writers have ascribed to them, the exercise of those powers, by good and evil agents, would either expose mankind to necessary and invincible error, or entirely destroy the credit and use of miracles, under the idea of criterions of truth, and authentic credentials of a divine mission. If we appeal to the evidence of revelation on this subject, we shall find, that the view which the Scripture gives us of good angels, of the devil and his angels, as also of the souls of departed men, is inconsistent with their liberty of working miracles: and the view which the sacred writers give us of the gods of paganism, is also absolutely inconsistent with their possessing a power of working miracles. Nevertheless it has been much disputed, how far it may be in the power of the devil to work miracles? or wherein the specific difference lies between the miracles of Moses, and those of Pharaoh's magicians? those of Jesus Christ and the Apostles, and those of Simon Magus and Apollonius Tyaneus? Whether the latter were any more than mere delusions of the senses; or whether any supernatural and diabolical power concurred with them. The author already referred to has considered the subject in all its bearings, and has shewn that the magicians, diviners, and sorcerers of antiquity, who pretended, by the assistance of the heathen deities, &c. to foretel future events, or to work miracles, are branded in Scripture as mere impostors, incapable of supporting their pretensions by any works or predictions beyond human power or skill.

The Scripture likewise reproaches the

pretences to inspiration and miracles, made by false prophets, in support of error and idolatry, as the sole effects of human craft and imposture. And, therefore, since angels, whether good or evil, the spirits of departed men, the heathen deities, magicians, and false prophets, are the only agents who have ever been conceived as capable of working miracles, either in opposition to God, or without an immediate commission from him; and the Scripture denies to all these the power of performing any miracles; it does in effect deny, that any single miracle has ever been performed without the immediate interposition of God. It is likewise alleged, that the Scriptures represent the one true God as the sole Creator and Sovereign of the world, which he governs by fixed and invariable laws; that to him they appropriate all miracles, and that they urge them as demonstrations of his divinity and sole dominion over nature, in opposition to the claims of all other superior beings. The Scriptures also uniformly represent all miracles as being, in themselves, an absolute demonstration of the mission and doctrine of the prophets, at whose instance they are performed; and never direct us to regard their doctrines as a test of the miracles being the effect of divine interposition. Accordingly, the miracles of Christ, in particular, were a demonstration (not a partial and conditional, but a complete and absolute demonstration) of his mission from God: and they were further designed to evince his peculiar character as the Messiah, or anointed; *i. e.* his regal commission and power, or his right by divine designation to dominion and judicature over mankind. And it may be observed, with respect to all the miracles of the New Testament, that their divinity, considered in themselves, is always either expressly asserted, or manifestly implied; and they are accordingly urged as a decisive and absolute proof of the divinity of the doctrine and testimony of their performers, without ever taking into consideration the nature of the doctrine, or of the testimony to be confirmed. It is also shown, that the Scriptures have not recorded any instances of real miracles performed by the Devil; in answer to the objections drawn from the case of the magicians in Egypt, from the appearance of Samuel, after his decease, to Saul, which was either the work of human imposture, or a divine miracle, and from our Saviour's temptation in the wilderness, which the writer, to whom we now refer, considers as a divine vision.

Miracles, considered as the peculiar works of God, afford a divine testimony to the person on whose account they are wrought, and to that doctrine or message, which he delivers in the name of God. And this proof from miracles, of the divine commission and doctrine of a prophet, is in itself decisive and absolute. It is also the most natural and agreeable to the common sense of mankind in all ages. It is the most easy and compendious proof of a new revelation. Miracles are further a very powerful method of conviction, making a strong impression upon the heart, at the same time that they carry light to the understanding. Nor is the necessity of miracles less evident than their propriety and advantage, in attesting a divine commission and propagating a new revelation. They also serve to revive and confirm the principles of natural religion, and to recover men from those two opposite extremes of atheism and idolatry. Finally, the evidence of miracles, whether of power or knowledge, is the fittest to accompany a standing revelation; because it is not confined to one age or nation, but may be extended over the whole globe, and conveyed to the most distant generations.

MIRROUR, in catoptrics, any polished body impervious to the rays of light, and which reflects them equally.

Mirrours were anciently made of metal; but, at present, they are generally smooth plates of glass, tinned or quicksilvered on the back part, and called looking-glasses. The doctrine of mirrours depends wholly on that fundamental law, that the angle of reflection is always equal to the angle of incidence. See OPTICS.

Parallel rays falling directly on a plane speculum are reflected back upon themselves; if they fall obliquely, they are reflected in the same angle, and parallel as they fell. Hence there is no such thing, properly speaking, as a focus belonging to a plane speculum, neither real nor virtual. The focus of parallel rays is called the solar focus; because in that the image of the sun is formed, and of all objects very remote. But the focus of any object situated near the mirrour, will have its distance from the vertex more or less than half the radius; the rule in all cases being as follows: "Multiply the distance of the object into the radius of the mirrour, and divide the product by the sum of the radius, and twice the distance of the object, the quotient will be the focal distance of a convex mirrour."

Again, for a concave mirrour, the same

product of the radius into the distance of the object, divided by the difference of radius and twice the distance of the object, will give the focal distance. And here we are to observe, that, as twice the distance of the object is lesser or greater than the radius, so the focus will be positive or negative, that is, behind the glass or before it.

The image of the object is formed in the focus proper to its distance, and, since the writers on optics demonstrate that the angles under which the object and its image are seen from the centre or vertex of the mirrour are always equal, it follows, that the image will be always in proportion to the object, as the focal distance to the object's distance. The position of the object will be always erect at a positive focus, or behind the speculum diminished by a convex, and magnified by a concave one. Hence, since a convex has but one, viz. an affirmative focus; so it can never magnify any object, howsoever posited before it.

The position of the image in a negative focus, or that before the glass, will be ever inverted; and, if nearer the vertex than the centre, it will be less; if further from it, it will be greater than the object; but in the centre it will be equal to the object, and seem to touch it.

The image formed by a plane speculum is erect, large as the life, at the same apparent distance behind the glass as the object is before it, and on the same side of the glass with the object. Those properties render this sort of mirrour of most common use, viz. as a looking-glass.

If the rays fall directly, or nearly so, on a plane mirrour, and the object be opaque, there will be but one single image formed, or at least be visible, and that by the second surface of the speculum, and not by the first, through which the rays do most of them pass.

But if the object be luminous, and the rays fall very obliquely on the speculum, there will be more than one image formed to an eye placed in a proper position to view them. The first image being formed by the first surface, will not be so bright as the second, which is formed by the second surface. The third, fourth, &c. images are produced by several reflections of the rays between the two surfaces of the speculum; and, since some light is lost by each reflection, the images from the second will appear still more faint and obscure to the eighth, ninth, or tenth, which can scarcely be discerned at all.

Mirrours may be divided into plane, concave, convex, cylindrical, conical, parabolical, and elliptical.

The properties of cylindrical mirrours are, 1. The dimensions of objects corresponding lengthwise to the mirrour are not much changed; but those corresponding breadthwise have their figures altered, and their dimensions lessened the further from the mirrour; whence arises a very great distortion. 2. If the plane of the reflection cut the cylindric mirrour through the axis, the reflection is performed in the same manner as in a plane mirrour; and if parallel to the base, the reflection is the same as in a spherical mirrour; if it cut it obliquely, the reflection is the same as in an elliptic mirrour. Hence, as the plane of reflection never passes through the axis of the mirrour, except when the eye and objective line are in the same plane; nor parallel to the base, except when the radiant point and the eye are at the same height; the reflection is therefore usually the same as in an elliptic one. 3. If a hollow cylindric mirrour be directly opposed to the sun, instead of a focus of a point, the rays will be reflected into a lucid line parallel to its axis, at a distance somewhat less than a fourth of its diameter. Hence arises a method of drawing anamorphoses, that is, wild deformed figures on a plane, which appear well proportioned when viewed in a cylindric mirrour.

In an elliptic mirrour, if a ray strike on it from one of its focuses, it is reflected into the other. Parabolic mirrours, as all the rays they reflect meet in one point, make the best burning-glasses.

MISCELLANEÆ, in botany, the name of the fifty-fourth order in Linnæus's "Fragments of a Natural Method," consisting of plants, which not being connected together by numerous relations, in their habit and structure, as the natural families, are assembled into one head, under the general title of miscellaneous plants.

MISCHIEF. Malicious mischief is an injury of such a gross nature, to personal property, that although it is not done with a felonious intention, or an intent to steal, the law has inflicted punishment upon it by various statutes. Of these are, statute 22 Henry VII. c. 11. against destroying dikes and bridges in the fens of Norfolk, &c. Statute 43 Elizabeth, c. 13. setting fire to stacks of corn, &c. and imprisoning persons on the borders for the purpose of obtaining

ransom. By 22 and 23 Charles II. c. 7. killing horses or cattle is felony; and maiming sheep, &c. a trespass, punishable with treble damages. By statute 1 Anne, s. 2. c. 9. captains and mariners setting fire to ships is felony; and also making a hole in a ship in distress, &c. is felony, and death by statute 12 Anne, s. 12. c. 18. By statute 6 George I. c. 23, the wilfully and maliciously tearing, cutting, spoiling, or defacing, the garments of any person passing in the streets or highways, and assaulting, with intent to do so, is felony. And there are other acts which relate to the prevention of setting fire to out-houses with corn, damaging fish-ponds, trees planted in gardens, cutting down sea-banks, hop-binds, setting fire to mines, preventing persons from buying corn, setting fire to goss, furze, &c.; wilfully burning engines in mines, fences in inclosures, breaking into houses of the Plate Glass Company, with intent to destroy utensils; breaking into houses to cut or destroy cloth, serge, linen, &c. in the loom, and other similar offences.

MISCHNAH, or MISNAH, the code or collection of the civil law of the Jews. The Jews pretend that when God gave the written law to Moses, he gave him also another not written, which was preserved by tradition among the doctors of the synagogue, till Rabbi Judah, surnamed the Holy, seeing the danger they were in, through their dispersion, of departing from the traditions of their fathers, judged it proper to reduce them to writing.

The misnah is divided into six parts: the first relates to the distinction of seeds in a field, to trees, fruits, tythes, &c. The second regulates the manner of observing festivals: the third treats of women, and matrimonial cases: the fourth of losses in trade, &c.: the fifth is on obligations, sacrifices, &c.: and the sixth treats of the several sorts of purification.

MISDEMESNOR, or MISDEMEANOUR, a crime less than felony. The term comprehends all indictable offences which are less than felony, as perjury, libels, conspiracies, assaults, &c.

MISNOMER, the using of one name for another. Where a person is described so that he may not be certainly distinguished and known from other persons; the omission, or in some cases, the mistake of the name shall not avoid the grant. But in actions and indictments, &c. the misnomer may be pleaded, and will abate the suit or indictment. But the omission of a letter or so is not material, if the word sounds the same; and courts of law properly discourage the plea.

MISPICKEL, a name given by mineralogists to a native alloy of iron and arsenic. This alloy may be made by fusion, it is white and brittle, and may be crystallized. Iron is capable of combining with more than its own weight of arsenic.

MISPRISION, a neglect, oversight, or contempt. It is chiefly applied to misprision of treason, which is a negligence in not revealing treason, or felony, to a magistrate, where a person knows it to be committed. It is also applied to great misdemeanours. It is, therefore, negative or positive, as it is an act or a concealment of crime. To avoid misprision of treason the party must make full discovery to a magistrate, and not merely to a private person. To counterfeit foreign coin, not current here, is misprision of treason. A misprision of felony may be by concealing it, or by taking back again a man's goods which have been stolen, which is now made felony. Concealing treasure trove falls under this head. In the class of positive misprisions, or high misdemeanours, are the mal-administration of high officers, and embezzling public money. Contempts against the king's authority, some of which incur a præmunire; contempts against the king's palace or courts. In the palace, if blood be drawn in a malicious assault, it is punishable by perpetual imprisonment, fine, and loss of the offender's right hand, 33 Henry VIII. c. 12. And striking, whether blood is drawn or not, in the king's superior courts, or at the assizes, is punishable with equal or greater severity. A rescue of a prisoner in such a court is punished with perpetual imprisonment, and forfeiture of goods, and the profit of lands during life.

Of a less degree, are reckoned also the injurious treatment of those who are under the immediate protection of a court of justice, the dissuading a witness from giving evidence, and the disclosing, by a grand jury, to the person indicted, of the evidence against him.

MISSIONARIES, such ecclesiastics as are sent by any Christian Church into Pagan or Infidel countries, to convert the natives, and establish the Christian religion among them.

MISSIVE, something sent to another, as missive letters; meaning letters sent from one to another upon business, in contra-distinction to letters of gallantry, points of learning, dispatches, &c.

MITCHELLA, in botany, so named from John Mitchell, M. D. a physician, in Virginia, a genus of the Tetrandria Monogynia class and order. Natural order of Aggregatæ. Rubiaceæ, Jussieu. Essential character: corollas one-petalled, superior, two on the same germ; stigmas four; berry bifid, four seeded. There is only one species, viz. M. repens, creeping Mitchella, which is a native of Carolina, Maryland, and Virginia.

MITELLA, in botany, a genus of the Decandria Digynia class and order. Natural order of Succulentæ. Saxifragæ, Jussieu. Essential character: calyx five-cleft; corolla five-petalled, inserted into the calyx; petals pinnatified; capsule one-celled, two-valved; valves equal. There are two species, viz. M. diphylla, two-leaved Mitella; and M. nuda, naked Mitella, natives of North America, and the northern parts of Asia.

MITHRIDATEA, in botany, so named in memory of Mithridates, King of Pontus, a genus of the Monandria Monogynia class and order. Natural order of Scabridæ. Urticæ, Jussieu. Essential character: calyx common, four-cleft, enlarged, fleshy, containing the seeds; corolla none; fruit globular, depressed; seeds solitary, arilled. There is only one species, viz. M. quadrifida, a milky tree, with sub-opposite, entire, ever-green leaves; flowers in racemes, seldom solitary, growing on the trunk and lower branches: females fewer, mixed with the males; fruit fleshy, the size of an apple. Native of the islands of Madagascar, Mauritius, and Bourbon.

MITRE, a sacerdotal ornament worn on the head by bishops, and certain abbots, on solemn occasions; being a sort of cap, pointed, and cleft at top. The high priest among the Jews wore a mitre or bonnet on his head. The inferior priests among the Jews had likewise their mitres, but in what respect they differed from that of the high priest is uncertain. Some contend that the ancient bishops wore mitres, but this is by no means certain. Those young women among the primitive Christians who professed a state of virginity, and were solemnly consecrated thereto, wore a purple and golden mitre as a badge of distinction. His holiness the Pope has no less than four different mitres, which are more or less rich, according to the solemnities of the festivals on which they are worn. The cardinals anciently wore mitres; some canons of cathedrals, in Popish countries, have the privilege of wearing the mitre; and some great families in Germany bear it for their crest.

Mitre, in architecture, is the workman's term for an angle that is just forty-five degrees, or half a right angle. If the angle be half of this, or a quarter of a right angle, they call it half a mitre.

MITTIMUS, a writ by which records are transferred from one court to another. This word is also used for the precept directed to a gaoler, under the hand and seal of a justice of the peace, for the receiving and safe keeping a felon, or other offender, by him committed to gaol.

MIXED *actions*, suits which concern real property, and personal, in as much as they are not only for recovery of land, but also of damages.

MIXT, in mathematics, when applied to an angle or figure, is when any one is comprized by both right or curved lines: applied to a number, it is to one that is partly an integer and partly a fraction, as $5\frac{1}{4}$. Mixt ratio is when the sum of the antecedent and consequent is compared with the difference of the antecedent and consequent, as if

$$4 : 3 :: 12 : 9$$
$$a : b :: c : d \text{ then,}$$
$$7 : 1 :: 21 : 3$$
$$a + b : a - b :: c + d : c - d.$$

MIXTURE, in chemistry, is distinguished from combination, because in it dissimilar particles are blended together more or less intimately, but without being united by any attraction; in which, therefore, no new qualities are required; in which the difference of parts is easily discovered, and these parts are capable of being separated by mechanical means.

MIZEN, in the sea language, is a particular mast or sail. The mizen-mast stands in the sternmost part of the ship. In some great ships there are two of these; when that next the main mast is called the main-mizen; and that next the pop, the bonaventure mizen. The length of the mizen-mast is, by some, accounted the same with the height of the main-top-mast from the quarter-deck; or half the length of the main-mast, and half as thick. The sail which belongs to the mizen-mast is called the mizen-sail. And when the word mizen is used at sea, it always means the sail. The use of the mizen is to keep the ship close to the wind, or when a ship rides at anchor, to back her a-stern, so that she may not foul her anchor, on the turning of the tide. The term mizen is used in the following phrases;

set the mizen, that is, fit the mizen-sail right as it should stand. Change the mizen, or bring the mizen-yard over to the other side of the mast. Peak the mizen, or put the mizen-yard right up and down by the mast. Spell the mizen, or let go the sheet and peak it up.

MNASIUM, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Ensatæ. Junci, Jussieu. Essential character: calyx one-leafed, three-parted; corolla one-petalled, three-parted, with a short tube; anthers four-cornered, terminated by an ovate leaflet; germ three-lobed; stigmas three, spiral. There is but one species, *viz.* M. paludosum, a perennial plant, found growing in the marshy woods of Guiana.

MNIARUM, in botany, a genus of the Monandria Digynia class and order. Essential character: calyx four-parted, superior; corolla none; seed one. There is but one species, *viz.* M. biflorum: this plant resembles minuartia so much in its appearance that, without examining the flower, it would be ranked with that genus; it is very smooth, dichotomous, covered all over with approximating, acerose, connate leaves; flowers terminating in pairs, subsessile, generally shorter than the leaves. It is a native of New Zealand, and Terra del Fuego.

MNIUM, in botany, a genus of the Cryptogamia Musci class and order. Natural order of Mosses. Generic character: capsule with a lid; calyptre smooth; bristle from a terminating tubercle: male flowers headed, or discoid. Twenty species are enumerated, among which M. hygrometricum is the most remarkable. If the fruit stalk be moistened at the bottom, the head makes three or four turns; and if the head be moistened it turns the contrary way. By some authors this is ranged with the Bryums; and Hedwig makes it a Koelreuteria.

MOAT, or DITCH, in fortification, a deep trench dug round the rampart of a fortified place, to prevent surprises.

The brink of the moat, next the rampart, is called the scarpe; and the opposite one, the counterscarpe. A dry moat round a large place, with a strong garrison, is preferable to one full of water; because the passage may be disputed inch by inch, and the besiegers, when lodged in it, are continually exposed to the bombs, granades, and other fire-works, which are thrown incessantly from the rampart into their works. In the middle of dry moats, there is sometimes another small one called cunette, which is generally dug so deep till they find water to fill it. The deepest and broadest moats are accounted the best, but a deep one is preferable to a broad one: the ordinary breadth is about twenty fathoms, and the depth about sixteen.

To drain a moat that is full of water, they dig a trench deeper than the level of the water to let it run off, and then throw hurdles upon the mud and slime, covering them with earth or bundles of rushes, to make a sure and firm passage.

MODE, in philosophy, denotes the manner of a thing's existence, which is twofold, *viz.* simple or mixed.

Simple modes are only combinations of the same simple idea: thus by adding units together, in distinct separate collections, we come by all the several modes of numbers, as a dozen, a score, a thousand, &c. Mixed modes, on the contrary, are compounded of simple ideas of different kinds, as beauty, which consists in a certain composition of colour and figure, causing delight in the beholder: such also is theft, which is the concealed change of the possession of a thing, without the consent of the proprietor.

MODE, in music, is defined to be a particular manner of constituting the octave; or, it is the melodious constitution of the octave, as it consists of seven essential sounds, besides the key or fundamental. See MUSIC.

MODEL, in a general sense, an original pattern, proposed for any one to copy or imitate. This word is particularly used in building, for an artificial pattern made in wood, stone, plaster, or other matter, with all its parts and proportions, in order for the better conducting and executing some great work, and to give an idea of the effect it will have in large. In all great buildings it is much the surest way to make a model in relievo, and not to trust to a bare design or draught. There are also models for the building of ships, &c. and for extraordinary stair-cases, &c.

Models are likewise used in painting and sculpture, whence, in the academies, they give the term model to a naked man or woman, disposed in several postures, to give an opportunity to the scholars to design him or her in various views and attitudes.

MODILLIONS, in architecture, ornaments in the corniche of the Ionic, Corinthian, and Composite columns.

The modillions are little inverted con-

soles, or brackets, in form of an S, under the soffit of the corniche, seeming to support the projecture of the larmier, though in reality they are no more than ornaments. See ARCHITECTURE.

MODULATION, in music, the art of conducting harmony, in composition, or extemporary performance, through those keys and modes which have a due relation to the fundamental key. Though every piece has its principal or governing key, yet, for the sake of contrast and relief, it is not only allowable, but necessary to pass from key to key, and from mode to mode: to assume different sharps or flats, and lead the hearer through those transitions of tone and harmony which interest the feelings and delight the ear. See MUSIC.

MODULE, in architecture, a certain measure or bigness, taken at pleasure, for regulating the proportions of columns, and the symmetry or disposition of the whole building. Architects generally choose the semi-diameter of the bottom of the column for their module, and this they sub-divide into parts or minutes.

MODUS *decimandi*, is a customary tithing different from the common law. It is generally a money compensation which has been taken in lieu of tythes, but the term extends to any mode of altering the usual course of tything. It must be *from* time immemorial, and it must be reasonable.

MOEHRINGIA, in botany, so named from Paul Henry Gerard Moehring, a physician, a genus of the Octandria Digynia class and order. Natural order of Caryophyllei. Essential character: calyx, four-leaved; petals four; capsule one celled, four valved. There is but one species, viz. M. muscosa an annual plant, with a slender root; stem filiform from eight to twelve inches long, upright, much branched; covered with linear, very narrow opposite leaves, dilated at the base; flowers axillary, erect, on slender, one flowered peduncles; it is a native of the mountains of France, Italy, Switzerland, Austria, and Silesia; among moss on rocks, by the trunks of trees, or little rills of water.

MOHAIR, in commerce the hair of a kind of goat, frequent about Angora, in Turkey; the inhabitants of which city are all employed in the manufacture of camblets, made of this hair.

MOINEAU, in fortification, is a flat bastion raised between two other bastions, when a re-entering angle before a curtain is too long. The moineau is commonly joined to the curtain, but it is sometimes separated from it by a foss, in which case it is called a detached bastion. The moineau is not raised so high as the works of the place, because it ought to be exposed to the fire of the place in case the enemy should lodge themselves in it.

MOISTURE, a term sometimes used to denote animal fluids, the juices of plants, or dampness of the air or other bodies.

MOLE. See TALPA.

MOLE *cricket*, the same with gryllo talpa. See GRYLLUS.

MOLE, a massive work of large stones laid in the sea by means of cofferdams; extending before a port, either to defend the harbour from the impetuosity of the waves, or to prevent the passage of ships without leave.

MOLLUGO in botany, a genus of the Triandria Trigynia class and order. Natural order of Caryophyllei. Essential character; calyx, five-leaved; corolla none; capsule three-celled, three valved. There are six species, these are all annuals and natives of warm countries.

MOLLUSCA, in natural history, the name of the second order of the Linnæan class Vermes. They are naked; furnished with tentacula, or arms; for the most part inhabitants of the sea; and by their phosphoreous quality, illuminate the dark abyss of the waters. This order is comprised of simple animals furnished with limbs, is distinguished in the following way. A. mouth placed above; of these there are seven genera, viz.

Actinia	Mammaria
Ascidia	Pedicellaria
Clava	Salpa
Dagysia	

B. mouth placed before: viz. the Derris and Pterotrachea.

C. mouth placed before: body with a lateral perforation: of these there are four genera, viz.

Doris	Limax
Laplysia	Tethys

D. mouth before: body surrounded with feelers on the fore part; two genera, viz. Holothuria and Terebella.

E. mouth before: body furnished with arms: of these there are seven genera, viz.

Clio	Scyllæa
Lernæa	Sepia
Lobaria	Triton
Onchidium	

F. mouth before: body furnished with

peduncles or feet: of these there are five genera, viz.

Amphitrite	Nereis
Aphrodita	Spio
Nais	

G. mouth placed beneath and generally central. There are five genera, *viz.*

Asterias	Medusa
Echinus	Physsophora
Lucernaria	

MOLOSSES, in commerce, the thick fluid matter remaining after the sugar is made, resembling syrup. See SUGAR.

MOLTING, the change of feathers, hairs, or horns, in birds and beasts.

MOLUCCELLA in botany a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character; calyx, bell-shaped, widening, broader than the corolla, spiny. There are three species, of which M. spinosa, prickly Molucca baum, has an annual root, with purplish, smooth stems, four feet in height, branching; leaves small, on short foot stalks acutely indented on their edges; calyx, cut into eight segments, each terminated by an acute spine; flowers in whorls. It is a native of the Levant.

MOLYBDATES, in chemistry, salts formed from the molybdic acid and the earths, alkalies, &c. They are mostly colourless, and soluble in water; they have a metallic taste. The prussiate of potash throws down from several of them a light brown coloured precipitate.

MOLYBDENUM is a metal of a greyish white colour, in the form of brittle infusible grains. Formerly two substances were confounded together, which being examined by the industrious and accurate Scheele; he gave to the one the name of plumbago, which is composed of carbon and iron; the other he called molybdenum. In colour it resembles lead, but in the analysis was obtained sulphur, and a whitish powder, which possesses the properties of an acid. This Bergman suspected to be a metallic oxide, which has since been demonstrated to be the case. Hitherto this metal is only obtained in grains, the greatest heat has not been sufficient to melt it into a button; its specific gravity is 7.4. When exposed to heat, in an open vessel, it gradually combines with oxygen, and is converted into a white oxide, which is volatilized in small brilliant needle form crystals. This oxide having the properties of an acid is called the molybdic acid.

Molybdenum is capable of combining with four different proportions of oxygen, and of forming four oxides, the black, the blue, the green, and the yellow or white. To the green is given the name of molybdous acid. It combines readily with sulphur, and in that state it is called molybdena, the sulphuret of molybdenum. This may be formed by distilling together one part of molybdic acid and five parts of sulphur. It will also combine with phosphorus. Muriatic acid has but little effect on the metal; but it dissolves the oxide. Molybdenum will unite with many of the metals forming with them alloys.

Molybdena, or sulphuret of molybdenum, occurs massive, disseminated, and rarely crystallized. Its colour is like that of fresh cut metallic lead. It occurs in granular distinct concretions; it is opaque, stains the fingers, leaves shining traces when drawn over paper; it is very soft and easily divisible in the direction of its laminæ. Specific gravity 4.5 to 4.7. It is infusible before the blow-pipe, but exhales a sulphureous odour; at a very high heat, it melts, gives out white fumes and burns with a blue flame; it consists of

Molydic acid	45
Sulphur	55
	100

It is found in Norway, Sweden, Saxony, and in Mont-Blanc in Switzerland.

MOLYBDIC } acid. See above. Mo-
MOLYBDOUS } lybdic acid combines with alkalies, earths, and several metallic oxides and forms MOLYBDATES, which see. This acid, combined with potash, forms a colourless salt: mixed with filings of tin and muriatic acid, it becomes blue, and precipitates flakes of the same colour, which disappear after some time. It is composed of

Molybdenum	67
Oxygen	33
	100

MOMENT, in the doctrine of time, an instant, or the most minute and indivisible part of duration. Strictly speaking, however, a moment ought not to be considered as any part of time, but only as the termination or limit thereof.

MOMENT, in the doctrine of infinites,

denotes the same with infinitesimal. See INFINITESIMAL.

MOMENTUM, in mechanics, signifies the same with impetus, or the quantity of motion in a moving body; which is always equal to the quantity of matter, multiplied into the velocity; or, which is the same thing, it may be considered as a rectangle under the quantity of matter and velocity.

If b denote a body and v the velocity of its motion, then bv will express or be proportional to its momentum m; again if B be another body, and v its velocity, then M is $= BV$ and $M : m :: BV : bv$.

MOMORDICA, in botany, a genus of the Monoecia Syngenesia class and order. Natural order of Cucurbitaceæ, Linnæus and Jussieu. Essential character: calyx five-cleft; corolla, five-parted; male filaments three: female, style trifid; pome opening elastically. There are eight species, the most remarkable of which is the M. balsamina, common mordica or male balsam apple: this has trailing stems like those of the cucumber and melon, extending three or four feet in length, sending out many side branches, which have tendrils; leaves shaped like those of the vine, smooth, deeply cut into several segments; it is a native of India. This plant is famous in Syria for curing wounds; the inhabitants cut open the unripe fruit, and then infuse it in sweet oil, exposed to the sun for some days, until the oil is become red. It is applied to a fresh wound dropped on cotton; the Syrians esteem this next to balsam of Mecca.

MOMOTUS, the *motmot*, in natural history, a genus of birds of the order Picæ. Generic character: bill strong, slightly curved and serrated at the edges; nostrils feathered; tongue long, narrow, and feathered at the edges; tail wedge-formed. M. brasiliensis, or the Brasilian motmot, is the only known species belonging to this genus, and is about eighteen inches long, and nearly of the size of a magpie. It is seen almost always alone, and on the ground, on which it makes its nest, in a hole deserted by some of the smaller quadrupeds. It lives principally upon insects, and abounds in the close woods of Brasil, Cayenne and Mexico. It is not valued either for its flesh or song.

MONADELPHIA, in botany, *a single brotherhood*: the name of the sixteenth class in Linnæus's system, consisting of plants with hermaphrodite flowers, in which all the stamina, or male organs of generation, are united below into one body or cylinder, through which the pointal passes. The principal characters are a permanent flower-cup, generally double; five heart shaped petals, closely embracing one another above; the anthers, kidney-shaped; the receptacle of the fructification, prominent in the middle of the flower; seeds kidney-shaped.

MONANDRIA, in botany, the name of the first class in Linnæus's Sexual System, consisting of plants with hermaphrodite flowers, which have only one stamen or male organ. This class is subdivided, like the other plain classes in the same system, from the number of the styles, or female organs, into two orders; viz. those that have one style, and those that have two.

MONARCHY, a government in which the supreme power is invested in a single person. There are several kinds of monarchies, as where the monarch is invested with an absolute power, and is accountable to none but God. It is an error to suppose, that a despotic or absolute monarch is a solecism in politics, and that there can be none such legally; for the contrary is true, and that in different parts of the world, and from various principles. In China it is founded on paternal authority, and is the basis of the government; in Turkey, Persia, Barbary, and India, it is the effect of religion; and in Denmark, the king is legally absolute by the solemn surrender which the people made to his predecessor of their liberties. Another kind of monarchy is that which is limited, where the supreme power is virtually in the laws, though the majesty of government and the administration is vested in a single person. Monarchies are also either hereditary, where the regal power descends immediately from the possessor to the next heir by blood; or elective, where the choice depends upon all who enjoy the benefit of freedom, or upon a few persons in whom the constitution vests the power of election. The dangers of monarchy are, tyranny, into which it is liable to degenerate; expence; exaction; military domination; unnecessary wars, waged to gratify the passions of an individual; risk of the character of the reigning prince; ignorance in the governors of the interests and accommodation of the people, and a consequent deficiency of salutary regulations; want of constancy and uniformity in the rules of government; and, proceeding from thence, insecurity of person and property. The advantages of this mode of government are, unanimity of council, activity, decision, secrecy, dispatch; the military strength and energy which result from these qualities of

government; the exclusion of popular and aristocratical contentions; the preventing, by a known rule of succession, of all competitors for the supreme power; and thereby repressing the hopes, intrigues, and dangerous ambition of aspiring citizens. An hereditary monarchy is allowed to be decidedly better than one that is elective. A crown, says the late learned Dr. Paley, is too splendid a prize to be conferred on merit. The passions or interests of the electors exclude all consideration of the qualities of the competitors. Among the advantages of an hereditary monarchy, we must not forget, that as plans of national improvement and reform are seldom brought to maturity by the exertions of a single reign, a nation cannot attain to the degree of happiness and prosperity to which it is capable of being carried, unless an uniformity of councils, a consistency of public measures and designs, be continued through a succession of ages. The benefit may be expected where the supreme power descends to the same race, and were each prince succeeds in some sort to the aim, pursuits, and disposition of his ancestor, than if the crown, at every change, devolve upon a stranger, whose first care will commonly be to pull down what his predecessor had built, and to substitute systems of administration which must give way to others of the succeeding sovereign. See Paley's "Principles of Moral and Political Philosophy."

MONARDA, in botany, so named from Nicholas Monarda, a physician of Seville, a genus of the Diandria Monogynia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: corolla irregular; the upper lip linear, involving the filaments; seeds four. There are seven species.

MONAS, in natural history, a genus of insects of the Vermes Infusoria class and order. Worm invisible to the naked eye, most simple, pellucid, resembling a point. There are five species. M. atomus, is found in sea water after it has been kept a long time: body a white point, something oval, with a minute black dot, variable in its position. M. lens, is transparent, with sometimes a greenish margin. It is found in all water. A round pellucid dot, frequently in masses, without the least vestige of intestines. M. termo, a most minute, simple, gelatinous point, found in most animal and vegetable infusions; of all known animals the most minute and simple, being so extremely delicate and transparent, as often to elude the most highly magnifying powers, blending as it were in the water in which it swims.

MONASTERY, a convent, or house built for the reception and entertainment of monks, mendicant friars, or nuns, whether it be an abbey, priory, &c.

Monasteries are governed by different rules, according to the different regulations prescribed by their founders. The first regular and perfect monasteries were founded by St. Pachomius, in Egypt: but St. Basil is generally considered as the great father and patriarch of the eastern monks; since in the fourth century he prescribed rules for the government of the monasteries, to which the anachorets and coenobites, and the other ancient fathers of the desarts, submitted: in like manner St. Benedict was stiled the patriarch of the western monks; he appeared in Italy towards the latter end of the fifth century, and published his rule, which was universally received throughout the west. St. Augustine being sent into England by St. Gregory the pope, in the year 596, to convert the English, he at the same time introduced the monastic state into this kingdom, which made such progress here, that within the space of 200 years there were thirty kings and queens who preferred the religious habits to their crowns, and founded stately monasteries, where they ended their days in solitude and retirement.

MONETIA, in botany, so called in honour of Jean Baptiste Pierre Antoine de Monet, a genus of the Tetrandria Monogynia class and order. Essential character: calyx four-cleft; petals four; berry two-celled; seeds solitary. There is but one species; viz. M. barlerioides, four-spined Monetia, a native of the East Indies and the Cape of Good Hope.

MONEY, a substance, commonly metal, and generally of a determined shape and weight, to which public authority has affixed a certain value to serve as a medium in commerce. We may refer our readers to the article Coin for much interesting matter on this subject. See also Medal. Money is usually divided into real or effective; and imaginary, or money of account. See Exchange. Real money includes all coins or species of gold, silver, copper, &c. which exist and have currency, such are guineas, louis d'ors, pistoles, ducats, &c. Imaginary money, or money of account, is that which has never existed, or at least which does not exist in real specie, but is a

denomination invented or retained to facilitate the stating of accounts by keeping them still on a fixed footing not to be changed, like current coins, which the authority of the sovereign raises or lowers according to the exigencies of the state. Of this kind are pounds in England and its dependencies, for which there never was a coin to answer. In France livres were of that kind, but for the franc of modern France, which answers in value to the livre, there is a corresponding coin. Among the ancients, the Greeks reckoned their monies of account by the drachma, minæ, and talenta. The drachma was equal to about 7¾*d.* sterling; of these 100 made a minæ, equal to 3*l.* 4*s.* 7*d.* and 60 minæ made a talent, equal to 193*l.* 15*s.*; hence 100 talents amounted to 19,375*l.* The same denominations were used in other Asiatic nations, but the values were different. Roman monies of account were the sestertius and the sestertium: the former was worth something less than 2*d.* and 1000 of these, equal the sestertium was worth 8*l.* 1*s.* 5½*d.* sterling. For the theory of coins and of money in general, and for a great variety of interesting and important information on these and other topics of political economy connected with them, we refer to a treatise on the coins of the realm by the Earl of Liverpool, and to Mr. Wheatley's Essay on the Theory of Money and the Principles of Commerce.

MONEY *bringing into court.* In some actions at law the defendant is allowed to pay a sum into court, which he contends is the fair amount of the plaintiff's just demand, and the plaintiff will afterwards proceed at his peril. This can only be done where the damages can readily be ascertained in money.

MONEYERS, officers of the mint, who work and coin gold and silver money, and answer all waste and charges.

MONKEY. See SIMIA.

MONNIERIA, in botany, so named from Mons. Monnier, of Paris, a genus of the Diadelphia Pentandria class and order. Essential character: calyx five-parted, with the upper segment long; corolla ringent; stamens two, the upper with two anthers, the lower with three; capsules five, one-seeded. There is but one species, viz. M. trifolia. This is an annual plant, with a dichotomous stem, ternate leaves, and white flowers in a bifid spike. It is a native of America.

MONOCHORD, in music, an ancient instrument, or machine, so called because it is furnished with only one string. Its use is to measure and adjust the ratios of the intervals, which it effects by the means of moveable bridges, calculated to divide the chord at the pleasure of the performer. The monochord was regarded by the ancients as the only means of forming the ear to the accurate perception, and the voice to the true intonation of those minute and difficult intervals which were then practised in melody. Lord Stanhope, who has employed much time on the subject of music, has described a new monochord, of which the following is his Lordship's account.

1. The wire is made of steel, which does not keep continually lengthening, like brass or iron. 2. The whole wire forms one straight horizontal line, so that the moveable bridge can be moved without altering the tension of the wire; which is not the case when the wire pulls downwards on the bridges. 3. The ends of the wire are not twisted round the two stout steel pins that keep it stretched; but each end of the wire is soft soldered in a long groove formed in a piece of steel, which goes over its corresponding pin. 4. One of these two-steel pins is strongly fastened by a brass slider, which is moved by means of a screw with very fine threads, this screw having a large micrometer head minutely divided on its edge, and a corresponding nonius; whence the tension of the wire may be very exactly adjusted. 5. A slider is fixed across the top of the moveable bridge, and is moved by means of another screw with very fine threads. 6. The slider is adjusted to the steel rod or scale, by means of mechanical contact against projecting pieces of steel firmly fixed on that steel scale, at the respective distances specified in the monochord table. 7. Each bridge carries a metallic finger, which keeps the wire close to the top of such bridge, while the remainder of the wire is made to vibrate. 8. The vibrations of the wire are produced by touching it with a piece of cork with the same elastic force, and always at the distance of one inch from the immoveable bridge. The Stanhope monochord, though very ingeniously constructed, is in some respects thought inferior to the monochord contrived by Mr. Atwood. In this gentleman's apparatus the string hangs vertically, its tension being regulated by a weight suspended at its lower extremity, a little below the place where the string comes into contact with a fixed pulley; the length of the string is terminated

at top by a horizontal edge: the other point of termination, which in the common monochords, as well as in many musical instruments, and in the Stanhope monochord, is a bridge over which the string is stretched, is in this construction effected by two steel edges vertically placed, that are capable of approaching, or of receding from, one another, like the cheeks of a vice: these being fixed on a frame worked by micrometer screws, can be easily moved in the vertical direction, so as to alter the length of the string in any desired proportion: these edges are separated occasionally by a spring, in order to let the string pass freely through, when its length is altered, and are closed again, so as to press the string slightly when that length is properly adjusted. By means of this construction the alteration of the tending force, by the application of bridges, &c. is wholly avoided. The scale placed under the string of this monochord is divided into 100 equal parts, and each of these by a micrometer screw into 1000 equal parts; so that, by the aid of a microscope and a proper index, the length of a given part of the string may be adjusted on the monochord true to the $\frac{1}{100000}$dth part of its whole length.

MONOCULUS, in natural history, a genus of insects of the order Aptera. Legs four to eight, formed for swimming, and very long; body covered with a crest, or shell, divided into segments; antennæ sometimes four, sometimes two, and sometimes without any; four feelers, in continual motion when swimming, the hind ones very small, and hook shaped. There are about 50 species, separated into sections. A. With a single eye, and crustaceous body. B. With a single eye, and bivalve shell; antennæ branched. C. With a single eye, and bivalve shell; antennæ simple. D. With a single eye, and bivalve shell; antennæ tufted at the tip. E. With a single eye, and univalve shell; antennæ two. F. Shell univalve; two eyes placed beneath. G. Shell bivalve; eyes two, placed on the back. The greater part of the Monoculi are very small water insects, requiring the assistance of the microscope for the investigation of their particular organs. To this there is, however, an exception in the M. polyphemus, which inhabits India. This is distinguished by the title of the Molucco crab, or king crab, and grows sometimes to the length of four feet. In this species the eyes, instead of being approximated, as is required in the Linnæan generic character, are extremely distant from each other, being situated towards the sides of the shell. "The whole structure of this animal is very remarkable, and particularly his eyes, which are between the fourth and last pair of claws on each side, reckoning from his mouth, and excluding the small pair there placed, are inserted the rudiments of another pair, or a claw broken off on each side at the second joint or elbow; on these extremities are the eyes like those of the horns of snails; but under the covert of a thick and opaque shell nature in that place has wonderfully contrived a transparent lantern, through which the light is conveyed."

MONODON, the *narwhal*, in natural history, a genus of Mammalia, of the order Cete. Generic character: tooth (sometimes two teeth) in the upper jaw, projecting strait forwards, long and spiral; spiracle on the head. The only species of this genus is M. monoceros, or the unicorn narwhal; this is found in the northern seas, and generally of the length of twenty feet from the mouth to the tail; from a socket in the upper jaw on one side, a tooth somewhat resembling a horn grows, in a perfectly straight direction, and a wreathed or screw-like form, to the length of six, and occasionally nine or ten feet, of a light yellow colour, and terminating in a sharp point, a circumstance by which it is discriminated from every other species of whales. The incipient protrusion of a second tooth on the other side of the jaw is generally perceivable, and in some instances, though rarely, both advance to maturity. The narwhals subsist principally upon flat fish. They are seldom observed in the open sea, and frequent the unfrozen spots near the coasts of the arctic regions, where they seldom fail of their favourite food, and resort in considerable numbers for the advantage both of certain supplies and convenient respiration. They are taken by the Greenlanders in great abundance by the harpoon; their flesh is eaten prepared in various ways, and the oil and intestines are also articles in great request at the table of these unfastidious people. The tendons are split into thin fibres, serving the purposes of thread, and the teeth are used sometimes for hunting horns, and more frequently as pillars and gate-posts in houses. These horns were formerly considered as indicative of royal state and magnificence, being employed as the ornaments of palaces, of which some traces are yet in existence. Medical virtue

was likewise attributed to them of the highest excellence.

MONOECIA, in botany, one of Linnæus's classes of plants, the twenty-first in order; in which the male and female flowers are placed separately on the same plant, or rather on different stalks growing from the same root. The plants in this class are not hermaphrodite: nor male and female upon the different roots; but androgynous; that is, they consist of male and female flowers upon different parts of the same plant. The orders in this class are derived from the number, union, and situation of the stamina, or male organs.

MONOGRAM, a character or cypher, composed of one, two, or more letters, interwoven; being a kind of abbreviation of a name, antiently used as a seal, badge, arms, &c. The use of arms is very ancient, as appears from Plutarch, and from some Greek medals of the time of Philip of Macedon and Alexander his son. The Roman labarum bore the monogram of Jesus Christ, which consisted of two letters, a P placed perpendicularly through the middle of an X, as we find it on many medals in the time of Constantine, these being the two first letters of the word ΧΡΙΣΤΟΣ. Thus under the eastern empire it is usual to find MIK, which are the monogram of Mary, Jesus, Constantine.

MONOGYNIA, in botany, the name of the first order or subdivision in the first thirteen classes of the Linnæan system, consisting of plants, which, besides their agreement in the classic character generally derived from the number of stamina, have only one style or female organ.

MONOTONY, an uniformity of sound, or a fault in pronunciation, when a long series of words are delivered in one unvaried tone.

MONOTROPA, in botany, a genus of the Decandria Monogynia class and order. Essential character: calyx none; petals ten, the five outer hollowed melliferous at the base; capsule five-valved. There are two species, viz. M. hypopithys, yellow bird's nest; and M. uniflora, natives of North America, and many parts of Europe.

MONSONIA, in botany, so named in honour of Lady Ann Monson, a genus of the Monadelphia Dodecandria class and order. Natural order of Gruinales. Gerania, Jussieu. Essential character: calyx five-leaved; corolla five-petalled; stamina fifteen, united into five filaments; style five-cleft; capsule five-grained. There are three species, all natives of the Cape of Good Hope.

MONSOON, in physiology, a species of trade wind, in the East Indies, which for six months blows constantly the same way, and the contrary way the other six months. However, it ought to be observed, that the points of the compass from whence the monsoons blow, as well as the times of their shifting, differ in different parts of the Indian ocean.

The cause of monsoons is this: when the sun approaches the northern tropic, there are countries, as Arabia, Persia, India, &c. which become hotter, and reflect more heat than the seas beyond the equator, which the sun has left; the winds, therefore, instead of blowing from thence, to the parts under the equator, blow the contrary way; and, when the sun leaves those countries, and draws near the other tropic, the winds turn about, and blow on the opposite point of the compass. See WIND.

MONTGOLFIER (STEPHEN JAMES), in biography, famous as the inventor of aerostatic balloons, was born at Annonay, thirty-six miles from Lyons, and there carried on an extensive manufacture of paper, in conjunction with his brother Joseph. They were distinguished for their ingenuity in this branch, and were the first in France who made the beautiful vellum paper. It is said, that the incident of covering a coffee-pot, in which water was boiling, with a spherical cap of paper, which rose in the air as the water heated, first gave him the idea of an air-balloon. Others affirm, that reflecting on the ascent of smoke and clouds in the atmosphere suggested the hint. However this were, it appears that Stephen, in the middle of November, 1782, made an experiment at Avignon with a bag of fine silk, of the shape of a parallelopipedon, and of forty cubic feet in capacity, to the aperture of which he applied burning paper till it was filled with a kind of cloud, when it ascended rapidly to the ceiling. This experiment was repeated by the two brothers at Annonay, with a success that induced them to form a machine of the capacity of six hundred and fifty cubic feet, which filled in like manner with smoke, ascended to the height of six hundred feet. They proceeded enlarging the experiment, till they had constructed a globe of linen, lined with paper, of the capacity of twenty-three thousand four hundred and thirty cubic feet, which, inflated with the smoke

of straw and chopped wool, rose to an elevation of about six thousand feet. This power of ascent M. Montgolfier attributed not merely to the rarefaction of the air from the heat (which appears to be the true cause), but to a species of gas specifically lighter than common air, supposed to be disengaged from the burning substances. When the event of these experiments was reported at Paris, the philosophers of that capital immediately thought of applying, for the purpose of inflation, a gas which they knew to be eight or ten times lighter than common air, namely inflammable air, and trials were immediately made upon that principle, which have proved highly successful. In the mean time Montgolfier continued to extend his plans, and on September 19, 1783, he exhibited before the king and royal family at Versailles a grand machine, near sixty feet high, and forty three in diameter, which ascended with a cage, containing a sheep, a cock, and a duck, and conveyed them through the air in safety to the distance of above ten thousand feet. Emboldened by this success, M. Pilatre de Rozier first offered himself to undertake the hazardous adventure of an aerial navigation in a new machine of Montgolfier's, of still larger dimensions. After first ascending alone to the height of eighty-four feet, he again seated himself in the car with the Marquis d'Arlandes, when they gave all Paris the astonishing spectacle of hovering in the air over that city for about nine minutes at the height of three hundred and thirty feet. This brilliant experiment caused the annual prize of the Academy of Sciences to be awarded to M. Montgolfier, and from that æra, October 19, 1783, the atmosphere has been a new field of human daring. The first principle of ascent, however, though applied in various succeeding instances, gradually gave way to the safer and more efficacious one of a gaseous fluid permanently lighter than the air. In one unfortunate instance the two modes were combined, and the result was, that the balloon caught fire, and occasioned the death of the first adventurer, Pilatre de Rozier, and his companion Romain. Montgolfier was rewarded for his discovery by admission into the Academy of Sciences, the cordon of St. Michael, and a pension of two thousand livres. He died in 1799.

MONTH, in chronology, the twelfth part of a year.

Time being duration, marked out for certain uses, and measured by the motion of the heavenly bodies, there thence results divers kinds of months as well as years, different from one another according to the particular luminary by whose revolution they are determined, and the particular purposes they are destined for: hence months are of two kinds, astronomical and civil. An astronomical month is that which is governed either by the motion of the sun or moon, and is consequently of two kinds, solar and lunar: a solar month is that time in which the sun seems to run through a whole sign, or the twelfth part of the ecliptic. Hence, if regard be had to the sun's true apparent motion, the solar month will be unequal, since the sun is longer in passing through the winter-signs than through those of the summer; but as he constantly travels through all the twelve signs in 365 days, 5 hours, and 49 minutes, the quantity of a mean month will be had, by dividing that number by 12; on this principle, the quantity of a solar month will be found to be 30 days, 10 hours, 29 minutes, 5 seconds. A lunar month is that space of time which the moon takes up in performing its course through the zodiac, or that measured by the motion of the moon round the earth; and is of three kinds, *viz.* periodical, synodical, and that of illumination. The lunar periodical month, is the space of time wherein the moon makes her round through the zodiac, or wherein she returns to the same point, being 27 days, 7 hours, 43 minutes, and 5 seconds.

The lunar synodical month, called also absolutely the lunar month and lunation, is the space of time between two conjunctions of the moon with the sun; or the time it takes from one conjunction with the sun to the next; or from one new moon to another: the quantity of a synodical month is 29 days, 12 hours, 44 minutes, 3 seconds, and 11 thirds. The quantity of a synodical month is not the same at all times, for in the summer solstice, when the sun seems to move slowest, the synodical month appeareth less, being about 29 days, 6 hours, 42 minutes; but in the winter, when the sun's motion seems faster, the moon does not fetch up the sun so soon, for which reason the synodical month then seems greater, *viz.* 29 days, 19 hours, and 37 minutes, according to the observation of the same astronomers: so that the first quantity given of the synodical month, is to be understood as to the mean motion. From what has been said, it may easily appear that the difference between a perio-

dical and synodical month is this; the first is called periodical in respect of the moon's orbit; but the synodical is so called in respect of its connection with the other luminary. Now after the time of its conjunction, the sun does not continue in the same place of the zodiac, but moves forwards towards the east, upon which it falls out that the moon, finishing its course, does not find the sun again in the same place where it left him, he being removed almost a whole sign from his former place, so that to overtake the sun again, it plainly appears that a certain space of time is requisite besides the periodical, which makes up the synodical month.

A civil or political month, consists of a certain number of days according to the laws and customs of the different countries wherein it is used, either having no regard to the solar or lunar months; as those of the Egyptians in their equal year; of the Romans in the year of Romulus, &c.; or coming pretty near to the solar astronomical month, as the Julian; or else the lunar astronomical, as the Jewish, Turkish, and others. The British, and most European nations, make twelve months in the year, viz. January, February, &c. See JANUARY, &c.

Civil solar months, are such civil months as are accommodated to the astronomical months, or those which are to consist alternately of thirty and thirty-one days, excepting one month of the twelve, which, for every fourth year, consisted of thirty days, and for the other years of twenty-nine. This form of civil months was introduced by Julius Cæsar; but under Augustus the sixth month, till then, from its place, called Sextilis, was denominated Augustus, in honour of that prince; and to make the compliment yet the greater, a day was added to it, so that it now consists of thirty-one days, though till then it had only thirty: to make up for which, a day was taken from February, so that from thenceforward it only consisted of twenty-eight days, and every fourth year of twenty-nine; though before it had ordinarily consisted of twenty-nine days, &c. and such are the civil or calendar months which now obtain throughout Europe.

Civil lunar months are to consist alternately of twenty-nine and thirty days: thus will two civil months be equal to two astronomical ones, abating for the odd minutes, and consequently the new moon will be hereby kept to the first day of each such civil month, for a long time together. However, to make them keep constantly pace with the civil months, at the end of each nine hundred and forty-eight months, a month of twenty-nine days must be added; or else every thirty-third month must consist of thirty days. This was the month in civil or common use among the Jews, Greeks, and Romans, till the time of Julius Cæsar.

MONTH, in law, is generally a lunar month of twenty-eight days, unless otherwise expressed.

MONTIA, in botany, so called in honour of Joseph Monti, a genus of the Triandria Trigynia class and order. Natural order of Portulaceæ, Jussieu. Essential character: calyx two-leaved; corolla one-petalled, irregular; capsule one-celled, two-valved. There is but one species, viz. M. fontana, water chickweed: native of many parts of Europe.

MONTINIA, in botany, so called in memory of Laurence Montin, a Swedish botanist, a genus of the Dioecia Tetrandria class and order. Natural order of Calycanthemæ. Onagræ, Jussieu. Essential character: calyx four-toothed, superior; petals four. Female filaments barren; style bifid; capsule oblong, two-celled. There is only one species, viz. M. acris, glaucous montinia, a native of the Cape of Good Hope.

MONUMENT, in architecture, a building destined to preserve the memory, &c. of the person who raised it, or for whom it was raised; such are a triumphal arch, a mausoleum, a pyramid, &c. The first monuments that were erected by the ancients, were of stones, which were laid over tombs, on which were cut the names and actions of the deceased. These stones were distinguished by various names, according as their figures were different: the Greeks called those which were square at the base, and were the same depth throughout their whole length, steles; from whence our square pilasters, or attic columns, are derived: those which were round in their base, and ended in a point at top, they called styles; which gave occasion to the invention of diminished columns: those which were square at the foot, and terminated in a point at the top, in the manner of a funeral pile, they called pyramids: to those whose bases were more in length than in breadth, and which rose still lessening to a very great height, resembling the figure of the spits or instruments used by the anci-

ents in roasting the flesh of their sacrifices, they called obelisks.

The Monument, absolutely so called among us, is a magnificent pillar, erected by order of Parliament, in memory of the burning of the city of London, anno 1666, in the very place where the fire began. This pillar is of stone, of the Doric order, and fluted. It is one of the boldest pieces of architecture that ever was attempted, being two hundred and two feet high, and the diameter fifteen; it stands on a pedestal forty feet high, and twenty-one feet square, the front being enriched with curious emblems in basso relievo: within are winding stairs, up to the very top.

MOOD, or Mode, in logic, called also syllogistic mood, a proper disposition of the several propositions of a syllogism, in respect of quantity and quality.

As in all the several dispositions of the middle term, the propositions of which a syllogism consists, may be either universal or particular, affirmative or negative; the due determination of these, and putting them together as the laws of argumentation require, constitute what logicians call the moods of syllogisms. Of these moods there are a determinate number to every figure, including all the possible ways in which propositions, differing in quantity or quality can be combined, according to any disposition of the middle term, in order to arrive at a just conclusion. There are two kinds of moods, the one direct, the other indirect.

The direct mood is that wherein the conclusion is drawn from the premises directly and immediately, as, "Every animal is a living thing, every man is a living animal; therefore every man is a living thing." There are fourteen of these direct moods, four whereof belong to the first figure, four to the second, and six to the third. They are denoted by so many artificial words framed for that purpose, viz. 1. Barbara, celarent, darii, ferioque. 4. Baralip, celantes, dabitis, fapesmo, frisesom. 2. Cesare, camestres, festino, baroco. 3. Darapti, selapton, disamis, datisi, bocardo, ferison. The use and effect of which words lie wholly in the syllables, and the letters whereof the syllables consist; each word, for instance, consists of three syllables, denoting the three propositions of a syllogism, viz. major, minor, and conclusion: add, that the letters of each syllable are either vowels or consonants; the vowels are A, which denotes an universal affirmative; E, an universal negative; I, a particular affirmative; and O, a particular negative: thus Barbara is a syllogism or mood of the first figure, consisting of three universal affirmative propositions: Baralip, one of the fourth figure, consisting of two universal affirmative premises, and a particular affirmative conclusion. The consonants are chiefly of use in the reduction of syllogisms. The indirect mood, is that wherein the conclusion is not inferred immediately from the premises, but follows from them by means of a conversion, as, "Every animal is a living thing, every man is an animal; therefore some living thing is a man."

Mood, or Mode, in grammar, the different manner of conjugating verbs, serving to denote the different affections of the mind. See Grammar.

MOON, luna, ☾, in astronomy, a satellite, or secondary planet, always attendant on our earth.

The moon being the nearest, and next to the sun, the most remarkable body in our system, and also useful for the division of time, it is no wonder that the ancient astronomers were attentive to discover its motions, and the orbit which it describes.

The motion of the moon in its orbit about the earth, is from west to east, and its orbit is found to be inclined to the ecliptic. The motion of the moon is also observed not to be uniform, and its distance from the earth is found to vary, which shows that it does not revolve in a circle about the earth in its centre; but its motion is found to be in an ellipse, having the earth in one of the foci. The position of the ellipse is observed to be continually changing, the major axis not being fixed; but moving sometimes direct and sometimes retrograde; but, upon the whole, the motion is direct, and it makes a complete revolution in a little more than eight years and a half. The excentricity of the ellipse is also found to change, that is, the ellipse is sometimes nearer to a circle than it is at other times. The inclination of its orbit is found likewise subject to a variation from 5° to 5° 18'. All these irregularities arise from the sun disturbing the moon's motion by its attraction. As the ellipse which the moon describes about the sun, is subject to a variation, the periodic time of the moon about the earth will also vary; in winter, the moon's orbit is dilated, and the periodic time is increased; and in summer, her orbit is contracted, and her periodic time is diminished. The periodic time of the moon

increases whilst the sun is moving from his apogee to his perigee, and decreases whilst he moves from his perigee to his apogee; and the greatest difference of the periodic times is found to be about twenty-two minutes and a half. The mean periodic time of the moon is $27^d\ 7^h\ 43\ 11''$, 5; this is called her sidereal revolution, being the mean time from her leaving any fixed star, till her return to it again. Now it is found by observation that the mean time from her leaving her apogee till she returns to it, is $27^d\ 13^h\ 18'\ 4''$; hence, the moon is longer in returning to her apogee than she is in making a revolution in her orbit, and therefore her apogee must move forward. The mean time from her leaving her node till she returns to it again, is $27^d\ 5^h\ 5'\ 35''$, 6, and this being less than her mean periodic time, it follows that she returns to her node before she has completed her revolution, and therefore her nodes must have a retrograde motion. The time between two mean conjunctions of the sun and moon, or from new moon to new moon, supposing their motions had both been uniform, is found by multiplying the periodic times of the earth and moon together, and dividing by their difference; taking therefore the mean periodic time of the moon and sun as already stated, we get the mean time from conjunction to conjunction to be $29^d\ 12^h\ 44'\ 2''$, 8, and this is called her synodic revolution. The true time from new to new moon will be sometimes greater and sometimes less than this.

The apparent diameter of the moon is found continually to vary; now the apparent diameter of any very distant body, varies inversely as its distance. Hence, as the apparent diameter of the moon increases, she must approach the earth; and when it decreases, she must recede from the earth. This variation of her apparent diameter agrees exactly with what ought to be the case, if the moon moved in an ellipse about the earth in one of its foci; we conclude therefore that the moon moves in an ellipse about the earth situated in one of its foci, as no other supposition will agree with the observed variation of the moon's diameter. From the variation of the sun's diameter, it appears in like manner, that the earth must revolve in an ellipse about the sun, having the sun in one of the foci. The earth moving in an ellipse about the sun in its focus, the nearer the earth comes to the sun, the more it is attracted by him, and this attraction increases in the same ratio as the square of the distance diminishes; and on the contrary, it decreases as the square of the distance increases. As therefore the earth approaches the sun all the time it moves from the aphelion to the perihelion, the attraction increases, and conspiring partly with the earth's motion, it accelerates the motion of the earth; and when the earth moves from perihelion to aphelion, the attraction acts partly against the earth's motion, and diminishes its motion. Thus, the velocity of the earth increases whilst it moves from the aphelion to perihelion, and decreases as much whilst it moves from perihelion to aphelion.

As the moon moves in an ellipse about the earth in its focus, she must, in like manner, by the earth's attraction, have her velocity increased from her apogee to perigee, and decreased as much from her perigee to apogee. These are the principal causes of the variation of the velocities of the earth and moon. But as the sun attracts the moon, as well as the earth attracts it, the attraction of the sun will cause another variation of the moon's velocity. Thus the moon being attracted both by the sun and earth, they will cause great irregularities in her motion; and hence, it is very difficult to compute the place of the moon. After finding the mean place of the moon, that is, the place where she would have been if her motion had been uniform, it requires not less than twenty corrections, in order to get the true place to a sufficient degree of accuracy. Sir I. Newton was the first person who pointed out the sources of these irregularities; but they are of a nature too difficult to admit of a proper illustration. When we view the moon with a telescope, we find that her surface is very rough with mountains and cavities; this appears from the very jagged boundary of the light and dark parts. Also, certain parts are found to project shadows always opposite to the sun; and when the sun becomes vertical to any of them, they are observed to have no shadow; these therefore must be mountains. Other parts are always dark on that side next the sun, and illuminated on the opposite side; these therefore must be cavities. Hence the appearance of the moon constantly varies, from its altering its situation in respect to the sun.

The tops of the mountains on the dark part of the moon, are frequently seen enlightened at a distance from the confines of the illuminated part. The dark parts have, by

some, been thought seas; and by others, to be only a great number of caverns and pits, the dark sides of which next to the sun, would cause those places to appear darker than the rest. The great irregularity of the line bounding the light and dark parts, on every part of the surface, proves that there can be no very large tracts of water, as such a regular surface would necessarily produce a line, terminating the bright part, perfectly free from all irregularity. Also, if there was much water upon its surface, and an atmosphere, as conjectured by some astronomers, the clouds and vapours might easily be discovered by our telescopes; but no such phenomena have ever been observed.

On April 9, 1787, Dr. Herschel discovered three volcanoes in the dark part of the moon; two of them seemed to be almost extinct, but the third showed an actual eruption of fire, or luminous matter, resembling a small piece of burning charcoal covered by a thin coat of white ashes; it had a degree of brightness about it, as strong as that with which such a coal would be seen to glow in faint daylight. The adjacent parts of the volcanic mountain seemed faintly illuminated by the eruption. A similar eruption appeared on May 4, 1783. On March 7, 1794, a few minutes before eight o'clock in the evening, Mr. Wilkins, of Norwich, an eminent architect, observed, with the naked eye, a very bright spot upon the dark part of the moon; it was there when he first looked at the moon, and the whole time he saw it, which was about five minutes; it was a fixed steady light, except the moment before it disappeared, when its brightness increased. The same phenomenon was also observed by Mr. T. Stretton, in St. John's Square, Clerkenwell, London. On April 13, 1793, M. Piazza, astronomer royal, at Palermo, observed a bright spot on the dark part of the moon; and several other astronomers have observed the same phenomenon.

It has been a doubt amongst astronomers, whether the moon has any atmosphere; some suspecting that at an occultation of a fixed star by the moon, the star did not vanish suddenly, but lost its light gradually, and thence concluded that the moon has an atmosphere. M. Schroeter, of Lilienthau, in the Duchy of Bremen, has endeavoured to establish the existence of an atmosphere, from the following observations. 1. He observed the moon when two days and a half old, in the evening soon after sunset, before the dark part was visible, and continued to observe it till it became visible. Two cusps appeared tapering in a very sharp, faint, prolongation, each exhibiting its furthest extremity faintly illuminated by the solar rays, before any part of the dark hemisphere was visible; soon after, the whole dark limb appeared illuminated. This prolongation of the cusps beyond the semicircle, he thinks must arise from the sun's rays being refracted by the moon's atmosphere. He computes also the height of the atmosphere, which refracts light enough into the dark hemisphere to produce a twilight, more luminous than the light reflected from the earth when the moon is about 32° from the new, to be 1356 Paris feet, and that the greatest height capable of refracting the solar rays, is 5376 feet. 2. At an occultation of Jupiter's satellites, the third disappeared, after having been 1″ or 2″ of time indistinct; the fourth became indiscernible near the limb; this was not observed of the other two. See the Philosophical Transactions, 1792.

Many astronomers have given maps of the moon; but the most celebrated are those of Hevelius in his Selenographia; in which he has represented the appearance of the moon in its different states from the new to the full, and from the full to the new; these figures Mayer prefers. Langrenus and Ricciolus denoted the spots upon the surface, by the names of philosophers, mathematicians, and other celebrated men; giving the names of the most celebrated characters to the largest spots. Hevelius marked them with the geographical names of places upon the earth. The former distinction is now generally used.

Very nearly the same face of the moon is always turned towards the earth, it being subject to only a small change within certain limits, those spots which lie near the edge appearing and disappearing by turns; this is called its libration. The moon turns about its axis in the same direction in which it revolves in its orbit. Now the angular velocity about its axis is uniform, and it turns about its axis in the same time in which it makes a complete revolution in its orbit; if therefore the angular motion about the earth were also uniform, the same face of the moon would always be turned towards the earth. For if the moon had no rotation on her axis, when she is on opposite sides of the earth, she would shew different faces; but if, after she has made half a revolution in her orbit, she has also turned half round her axis, then the face,

which would otherwise have been shewn, will be turned behind, and the same face will appear. And thus, if the moon's angular velocity about her axis were always equal to her angular velocity in her orbit about the earth, the same side of the moon would be always towards the earth. But as the moon's angular velocity about her axis is uniform, and her angular velocity in her orbit is not uniform, their angular velocities cannot continue always equal, and therefore the moon will sometimes show a little more of her eastern parts, and sometimes a little more of her western parts; this is called a libration in longitude. Also, the moon's axis is not perpendicular to the plane of her orbit, and therefore at opposite points of her orbit, her opposite poles are turned towards the earth; therefore her poles appear, and disappear, by turns; this is called a libration in latitude. Hence, nearly one half of the moon is never visible at the earth, and therefore nearly one half of its inhabitants (if it have any) never saw the earth, and nearly the other half never lose sight of it. Also the time of its rotation about its axis being a month, the length of the lunar days and nights will be about a fortnight each. It is a very extraordinary circumstance, that the time of the moon's revolution about her axis should be equal to that in her orbit.

Sir I. Newton, from the altitude of the tides upon the earth, has computed the altitude of the tides on the moon's surface to be ninety-three feet, and therefore the diameter of the moon, perpendicular to a line joining the earth and moon, is less than the diameter directed to the earth, by one hundred and eighty-six feet. Hence, says he, the same face must always be towards the earth, except a small oscillation; for if the longest diameter should get a little out of that direction, it would be brought into it again by the earth's attraction. The supposition of D. de Mairan is, that the hemisphere of the moon next the earth is more dense than the opposite one; and, hence, the same face would be kept towards the earth, upon the same principle as before.

When the moon is in conjunction with the sun, she is then said to be new, and her dark side being next to the earth, she is then invisible. As she recedes from the sun, we first discover some of her bright part, and she appears horned till she gets 90° degrees from the sun, when she appears half enlightened, or dichotomised; from thence, till she comes into opposition, she appears above half enlightened, or gibbous; and at opposition she appears full orbed, the same face being then turned towards the earth which is towards the sun, and she is then said to be at her full. And from opposition to conjunction, her apparent bright part decreases as it before increased. When the moon is about three days from the new; the dark part is very visible, by the light reflected from the earth, which is moonlight to the lunarians, considering our earth as a moon to them; and in the most favourable state, some of the spots may be then seen. But when the moon gets into quadratures, its great light prevents the dark part from being seen. According to Dr. Smith, the strength of moon-light at the full moon, is ninety thousand times less than the light of the sun; but from experiments made by M. Bouguer, he concluded it to be three hundred thousand times less. The light of the moon, condensed by the best mirrors, produces no sensible effect upon the thermometer.

Our earth, in the course of a month, shows the same phases to the lunarians, as the moon does to us; the earth is at the full, at the time of the new moon, and at new, at the time of the full moon. The surface of the earth being about thirteen times greater than that of the moon, it affords thirteen times more light to the moon than the moon does to us.

Dr. Herschel has measured the height of a great many of the lunar mountains, and finds, that a few excepted, they generally do not much exceed half a mile. Before he measured them, they were reckoned much higher, being generally over-rated. He observes, that it should be examined whether the mountain stands on level ground, which is necessary that the measurement may be exact. As the spectator is carried by the earth's rotation, his horizon will continually change its situation, and therefore it will continually cut the moon's orbit, at different points, till it has gone through the whole orbit; and the inclination of the orbit to the horizon will be continually changed. Now the difference between the times of the rising of the moon on two successive nights, will depend upon the angle which the moon's orbit makes with the horizon; the less the angle is, the less the moon will have descended below the horizon, at the time when the horizon is brought into the same situation it was twenty-four hours before; therefore, when the angle which the moon's orbit makes with the horizon is the

least, there will be the least difference of the times of her rising. Now, that angle is the least, when the first point of Aries rises, at which time, in the latitude of London, there is only about seventeen minutes difference of the moon's rising on two successive nights. Now, about the 22d of September, the first point of Aries rises at the time the moon rises, if the moon be then at the full, because it will then be at the beginning of Aries. In this case, therefore, the moon will rise about the full for several nights, with but a small difference of the times of her rising. This happening in the time of harvest, it is called the harvest moon. As the full moon may not happen on the 22d of September, that which happens nearest to it is called the harvest moon. The same small difference of the times of rising of the moon happens every month, but it not happening at the full moon, and at that time of the year, it is not taken notice of. The greatest difference of the times of the moon's rising at London on two successive nights, is about one hour and seventeen minutes; and this happens when the moon is in the first point of Libra, and therefore it happens at the vernal full moons.

There is a phenomenon called the horizontal moon, which is this, that it appears larger in the horizon than in the meridian; whereas, from its being further from us in the former case than in the latter, it subtends a less angle when in the horizon. It is perhaps not easy to give a satisfactory answer to this deception. Gassendus thought, that as the moon was less bright in the horizon than in the meridian, we looked at it, in the former situation, with a greater pupil of the eye, and therefore it appeared larger. But this is not agreeable to the principles of optics, since the magnitude of the image upon the retina of the eye does not depend upon the size of the pupil. Des Cartes thought that the moon appeared largest in the horizon, because when comparing its distance with the intermediate objects it appeared then furthest off; and as we judge its distance greater in that situation, we, of course, think it larger, supposing that it subtends the same angle. Dr. Berkeley accounts for it thus: faintness suggests the idea of greater distance; the moon appearing faintest in the horizon, suggests the idea of greater distance; and, supposing the angle the same, that must suggest the idea of a greater tangible object. He does not suppose the visible extension to be greater, but that the idea of a greater tangible extension is suggested, by the alteration of the visible extension. He says, 1. That which suggests the idea of greater magnitude, must be something perceived; for that which is not perceived can produce no effect. 2. It must be something which is variable, because the moon does not always appear of the same magnitude in the horizon. 3. It cannot lie in the intermediate objects, they remaining the same; also, when these objects are excluded from sight, it makes no alteration. 4. It cannot be the visible magnitude, because that is least in the horizon. The cause, therefore, must lie in the visible appearance, which proceeds from the greater paucity of rays coming to the eye, producing faintness. Mr. Rowning supposes, that the moon appears furthest from us in the horizon, because the portion of the sky which we see, appears not an entire hemisphere, but only a portion of one; and hence, we judge the moon to be further from us in the horizon, and therefore larger. Dr. Smith, in his optics, gives the same reason. The same circumstances take place in the sun. Also, if we take two stars near each other in the horizon, and two other stars near the zenith at the same angular distance, the two former will appear at a much greater distance from each other than the two latter. On this account, people are, in general, much deceived in estimating the altitudes of the heavenly bodies above the horizon, judging them to be much greater than they are. The lower part of a rainbow also appears much wider than the upper part; and this may be considered as an argument that the phenomenon cannot depend entirely upon the greater degree of faintness of the object when in the horizon, because the lower part of the bow frequently appears brighter than the upper part, at the same time that it appears broader. Also, faintness can have no effect upon the angular distance of the stars; and as the difference of the apparent distance of the two stars, whose angular distance is the same in the horizon and the zenith, seems to be fully sufficient to account for the apparent variation of the moon's diameter in these situations, it may be doubtful whether the faintness of the object enters into any part of the cause.

The mean distance of the moon from the earth is about two hundred and thirty-nine thousand miles; and her semidiameter is nearly three elevenths of the radius of the earth, or about one thousand and eighty-one miles. And as the magnitudes of sphe-

rical bodies are as the cubes of their radii, the magnitude of the moon : magnitude of the earth :: $3^3 : 11^3$ :: 1 : 49 nearly. See Vince's Astronomy.

MOORE (Sir Jonas), in biography, an eminent English mathematician in the seventeenth century, was born at Whitlee in Lancashire, about the year 1620. He enjoyed the advantages of a liberal school education, and afterwards applied himself principally to the study of the mathematics, for which, from his childhood, he had discovered a strong partiality. This favourite pursuit he cultivated with great diligence and success, and acquired such reputation for his proficiency, that during one of the expeditions of King Charles I. into the northern parts of England, he was introduced to his Majesty, as a person studious and learned in those sciences. Upon conversing with him the King expressed much approbation of his acquirements, and gave him a promise of encouragement; which laid the foundation of his future fortune. Afterwards he was appointed mathematical tutor to the King's second son, James, to instruct him in arithmetic, geography, the use of the globes, &c. During Cromwell's government, he appears to have followed the profession of a public teacher of mathematics; for he is styled in the title-pages of some of his publications, "professor of the mathematics." Mr. Granger says, in his "Biographical History of England," that he was employed by the commissioners, for draining and dividing the fens; and in his survey took notice that the sea made a curve line on the beach, from which he took the hint to keep it effectually out of Norfolk. This added much to his reputation; but no mention is made of the period of his life when he was thus occupied. After the restoration of King Charles II. he was noticed and employed by that prince, who bestowed on him the honour of knighthood, and at length promoted him to the important office of surveyor-general of the ordnance. He appears to have been a favourite both with the King and the Duke of York, who often consulted him, and followed his advice upon many occasions. To his honour it ought to be recorded, that he frequently availed himself of his interest at court for the advancement of learning, the encouragement of merit, and the establishment of institutions highly favourable and beneficial to the interests of the public, and of science in general. He patronised the famous Mr. Flamstead, who had but a very scanty income at Cambridge when he took him under his protection. In connection with Sir Christopher Wren, he persuaded the King to erect Flamstead house at Greenwich, for a public observatory, in 1675, recommending Mr. Flamstead to be the King's astronomer, to make observations there; and being surveyor-general of the ordnance himself, this was the reason why the salary of the astronomer-royal was made payable out of the office of ordnance. Being elected a governor of Christ's hospital, he appears to have been instrumental in persuading the King to found the mathematical school there, with the allowance of a handsome salary for a master to instruct a certain number of the boys in mathematics and navigation, to qualify them for the sea-service. It ought not to be concealed, that the Duke of York also took a zealous and active part in determining his brother to found this useful establishment. This foundation presented Sir Jonas with an opportunity of exerting his abilities in a manner agreeable to his wishes, namely, that of serving the rising generation. And reflecting within himself on the benefit which the nation might receive from a mathematical school if properly conducted, he made it his utmost care to promote its improvement. In pursuance of his Majesty's grant, the school was established; but there was still wanting a methodical institution, from which the youths might receive such necessary helps as their studies required: a laborious work, from which his other great and assiduous employments might very well have exempted him, had not a predominant regard to a more general usefulness determined him to devote all the leisure hours of his declining years to the improvement of such an useful and important seminary of learning. Having thus engaged himself in the prosecution of this generous undertaking, he sketched out a plan or system of mathematics for the use of the school, and afterwards drew up and printed several parts of it himself; but death put an end to his labours, before the work was completed. We are not informed of the year when this event took place; but it could not be long before 1681, when the work was published by his sons-in-law, Mr. Hanway and Mr. Potinger, who spared neither expense nor labour to have it finished in the best manner, and securing proper assistants for that purpose. Besides the New System of the Mathematics, &c. in two volumes, quarto, above mentioned, Sir Jonas published, Arithmetic, in two

[illegible], viz. [illegible], and Navi[illegible]. To [illegible] two Treatises, [illegible] Geometrical [illegible] [illegible] Euclid [illegible] the first Books of Apollo[illegible] Conical Sections analyzed, 16[illegible] [illegible]. A Mathematical Compendium: [illegible] Practices in Arithmetic, Geometry, and Astronomy, Geography, and Navigation, &c. &c. the fourth edition of which is dated in 170[illegible], 12mo.: A General Treatise of Artillery: or, Great Ordnance. Written in Italian by Thomas Moretti of Brescia. Translated into English, with Notes thereupon, and some Additions out of French for Sea-gunners. By Sir Jonas Moore, Knt. octavo, with the date of 1688.

MOORING, or MOARING, in the sea-language, is the laying out the anchors of a ship in a place where she can ride secure. Mooring across, is laying out an anchor on each side: and mooring along, is to have an anchor in a river and a hawser on shore. When ships are laid up in ordinary, or are under orders of fitting for the sea, the moorings are laid out in harbours; and consist of claws, pendent chains, cables, bridles, anchors, swivels, jew's-harps, buoys, and chains.

MOOT, a difficult case argued by the young barristers and students at the inns of court, by way of exercise, the better to qualify them for practice, and to defend the causes of their clients. This, which is called mooting, is the chief exercise of the inns of court. Particular times are appointed for the arguing moot-cases: the place where this exercise is performed was anciently called moot-hall; and there is a bailiff, or surveyor of the moots, annually chosen by the bench, to appoint the moot men for the inns of chancery, and to keep an account of the performance of exercises.

MORÆA, in botany, so called in honour of Robert Moore, of Shrewsbury, a genus of the Triandria Monogynia class and order. Natural order of Ensatae. Irides, Jussieu. Essential character: corolla six petalled, the three inner parts spreading narrower, stigma trifid. There are seventeen species. La[illegible] remarks that the flower of Moræa [illegible] from that of Iris, in having all the [illegible] equally spreading; this being the [illegible]. Gaertner is of opinion that [illegible] [illegible] and might [illegible] be mixed partly with Iris, and partly with Ixia.

MORALITY, the science and doctrine of morals, [illegible] called ethics. See PHILOSOPHY.

MORAVIANS, HERRNHUTTERS, or UNITAS FRATRUM, in church history, a denomination of Christians, concerning whose origin, history, and character, various contradictory reports have been published. Crantz divides their history into what he calls ancient and modern. The former refers to them before the time of their settlement in Upper Lusatia, in 1722: the latter after that period. The United Brethren claim the famous Huss, and Jerome of Prague, as their martyrs. M. Crantz, however, places the beginning of the Church of the United Brethren in the year 1457, and says, that it arose out of the scattered remains of the followers of Huss. In the year 14[illegible] this people became reunited to the Greek Church; but on the taking of Constantinople by the Turks about two years afterwards, that union was again dissolved. After this, various attempts were made to form them into a regularly constituted church, but without success. At length, after many vexations and commotions among themselves, and sundry persecutions from others, they obtained permission to withdraw to a part of the king's domain, on the boundary between Silesia and Moravia. In the same year, 1457, they formed their church fellowship, calling themselves "Unitas Fratrum," or "Fratres Unitatis," the United Brethren. From this period to the Reformation they suffered many cruel and vexatious persecutions; yet they preserved their unity, and formed a kind of alliance with the Waldenses, who had for many centuries opposed many of the corrupt practices and doctrines of the Romish church. After the Reformation, they professed to adhere to the Augsburgh Confession, yet they continued a distinct body. After various persecutions and discouragements, during the seventeenth century, they became in a manner extinct: until about the year 1720, when they began to revive in Bohemia; but as no free toleration could be obtained for them in that country, they agreed to emigrate. Applications were accordingly made to Nicholas Lewis, Count of Zinzendorf, who readily granted them permission to settle on his estates in Upper Lusatia. Thither, in 17[illegible], a company of them repaired, and formed the settlement of Herrnhut, from whence they are sometimes called Herrnhutters. Their friend and protector, Count Zinzendorf, at length became a convert to

the faith and practices of the Moravian Brethren, and commencing preacher, was, in the year 1735, chosen to be their bishop. From this period the sect of the Moravians began to flourish rapidly. Count Zinzendorf was a zealous and enterprising man, though enthusiastical and mystical in a very high degree. His exertions were of singular service to the cause of the brethren, though his extravagancies sometimes brought them into contempt with the sober and reflecting part of mankind. It is even acknowledged, on the part of the Count's friends, that much of the extravagance and absurdity that has been attributed to him, owes its origin, or at least its publication, to those persons who wrote his extempore sermons in short-hand, and afterwards published them with all their indelicacies and imperfections about them.

The church of the United Brethren is episcopal, and their church government is conducted with great form and regularity. Questions of dispute are settled by ballot, and in cases of real or supposed importance are often decided by lot. The lot is deemed a solemn appeal to heaven, and is made use of with great seriousness. They have œconomies, or choir-houses, where they live together in community: the single men and single women apart, widows and widowers apart, each under the superintendance of elderly persons of their own class. At Fairfield, near Manchester, there is a Moravian settlement; it is a small village, uncommonly neat and clean, consisting of one large open street, having a handsome chapel, and a small public-house for the reception of strangers who visit the settlement from Manchester and the neighbourhood, particularly on Sundays and other holidays. The Moravians are very strict in their attention to the youth of both sexes, and never suffer them to come together or to marry without the previous consent of the church; and as the lot must be cast to sanction their union, each receives his partner as a divine appointment. Though the Moravians are united in one body, they are by no means illiberal in their views towards other christians, who hold what they conceive to be the essentials of religion, and pay divine adoration to Jesus Christ. In doctrine they appear to be inclined to Sabellianism. They address all their prayers to Jesu, or The Lamb, and they have been accused, not without reason, of adopting a phraseology in their hymns and prayers not consistent with the rules of decency and chastity. They are, however, a very harmless and unoffending people. They appear to be Arminians in opposition to Calvinism, and they reject the use of the term Trinity, and some other popular and unscriptural terms and phrases. In zeal, tempered with modesty, and in silent perseverance in attempting to convert the heathen world to Christianity, the Moravians are unequalled. While some other bodies of Christians are filling the world with pompous details of their missionary labours, and are every day and hour sounding the trumpet of their own fame to all the world, the Moravian missionaries are quietly and successfully pursuing their labour of love in almost every part of the known world. They have settlements in various parts, particularly in the following places: begun 1732, in the Danish West India Islands; in St. Thomas, New Herrnhut, Nisky; in St. Croix, Friedensburg, Friedenstal; in St. Jan, Bethany, and Emmaus. In 1733, in Greenland, New Herrnhut, Lichtenfels, and Lichtenau. In 1734, North America, Fairfield in Upper Canada, and Goshen on the river Muskingum. In 1736, at the Cape of Good Hope, Bavians Kloof. In 1738, in South America, among the negro slaves at Paramaribo and Sommelsdyk; among the free negroes at Bambey, on the Sarameca, and among the native Indians at Hope on the river Corentyn. In 1754, in Jamaica, two settlements in Elizabeth parish. In 1756, in Antigua, at St. John's, Grace hill, and Grace bay. In 1760, near Tranquebar in the East Indies, Brethren's Garden. In 1764, on the Coast of Labrador, Nain, Okkak, and Hopedale. In 1765, in Barbadoes, Sharron near Bridgetown. In the same year, in the Russian part of Asia, Sarepta. In 1775, in St. Kitt's, at Basseterre. In 1789, in Tobago, Signal Hill. By the latest accounts published, most of these settlements appear to be in a flourishing state.

Whoever wishes to see a more detailed account of the Moravians, will do well to consult Crantz's Ancient and Modern History of the United Brethren, the same author's History of the Mission in Greenland, La Trobe's edition of Spangenburgh's Exposition of Christian Doctrine, also Rimius's Narrative of the Moravians, Bishop Lavington's Moravians compared and detected, and the Periodical Accounts of the Missions of the United Brethren.

MORBID, among physicians, signifies diseased or corrupt, a term applied either

to an unsound constitution, or to those parts or humours that are infected by a disease.

MORDANT, in dying. When a substance to be dyed has little or no attraction to the matter on which the colour depends, so as either not to be capable of abstracting it from its solvent, or of retaining it with such force as to form a permanent dye, then some intermediate substance is used, which acts as a bond of union between them: this substance is called a mordant. See DYING.

MORDELLA, in natural history, a genus of insects of the order Coleoptera: antennæ moniliform or pectinate; head deflected and bent under the neck; shells curved downwards towards the tip; at the base of the abdomen, and before the thighs, is a broad lamina. There are about thirty-four species, divided into sections. A. antennæ, moniliform; fore feelers clavate, hind feelers filiform. B. antennæ pectinate; feelers filiform. The most common of the British species is M. aculeata, measuring little more than a quarter of an inch in length; it is black and smooth; the legs are rather long, and the insect, when disturbed, has the power of leaping or springing to a small distance. It is found on plants in the gardens. M. clavicornis is entirely piceous; antennæ clavate; an inhabitant of England, and found commonly on the flowers of the rhæum rhabarbarum.

MOREL, the phallus esculentus of Linnæus, a plant that grows on moist banks and wet pastures, and springs up in the early parts of spring. It is used for culinary purposes.

MORINA, in botany, so named in honour of Louis Morin, M. D., member of the Academy of Sciences at Paris, a genus of the Diandria Monogynia class and order. Natural order of Aggregatæ. Dipsaceæ, Jussieu. Essential character: calyx of the fruit one leafed, toothed; of the flower bifid; corolla irregular; seed one, under the calyx of the flower. There is but one species, *viz.* M. persica, which has a thick taper root, running deep into the ground; stem nearly three feet in height, smooth, and purplish towards the bottom, and green to the top; at each joint come out three or four prickly leaves, four or five inches long, of a lucid green on the upper side, and of a pale green underneath, armed on their edges with spines; flowers axillary on each side, some white and others red on the same plant. It is a native of Persia.

MORINDA, in botany, *Indian mulberry*, a genus of the Pentandria Monogynia class and order. Natural order of Aggregatæ. Rubiaceæ, Jussieu. Essential character: flowers aggregate, one-petalled; stigma bifid; drupes aggregate. There are three species, natives of the East and West Indies.

MORISONIA, in botany, so named in honour of Robert Morison, M. D., a genus of the Monadelphia Polyandria class and order. Natural order of Putamineæ. Capparides, Jussieu. Essential character: calyx single, bifid; petals four; pistillum one; berry with a hard rind, one-celled, many-seeded, pedicelled. There is but one species, *viz.* M. Americana, a native of South America and the islands of the West Indies; flowering there in July, and bearing fruit in November. In Martinico it is called Bois Mahoula, or Devil's wood.

MARMYRUS, in natural history, a genus of fishes of the order Abdominales. Generic character: snout protruded, mouth terminal; teeth numerous and notched; aperture of the gills without a cover; gill membrane with one ray; body scaly. This genus has been recently investigated by M. Geoffrey, with considerable minuteness, and he has enumerated nine distinct species, of which Linnæus was acquainted only with three. The body is compressed, and the tail of a somewhat cylindrical and inflated appearance, and of a considerable length. It contains the glands, from which is secreted the oily matter appearing along the lateral line; the stomach is highly muscular, and the air-bladder nearly of the whole length of the abdomen. Most of the species are inhabitants of the river Nile.

MOROCCO, in commerce, a fine kind of leather, prepared of the skin of an animal of the goat kind, and imported from the Levant, Barbary, &c.

The name was probably taken from the kingdom of Morocco, whence the manner of preparing it was borrowed, which is this: the skins being first dried in the hair, are steeped in clear water three days and nights; then stretched on a tanner's horse, beaten with a large knife, and steeped afresh in water every day till they be well come: then they are thrown into a large vat in the ground full of water, where quick lime has been slaked, and there lie fifteen days; whence they are taken, and again returned every night and morning. Then they are thrown into a fresh vat of lime and water, and shifted night and morning for fifteen days longer; then rinsed in clear

water, and the hair taken off on the leg with the knife, returned into a third vat, and shifted as before for eighteen days; steeped twelve hours in a river, taken out, rinsed, put in pails, where they are pounded with wooden pestles, changing the water twice; then laid on the horse, and the flesh taken off; returned into pails of new water, taken out, and the hair side scraped; returned into fresh pails, taken out, and thrown into a pail of a particular form, having holes at bottom: here they are beaten for the space of an hour, and fresh water poured on from time to time; then being stretched on the leg, and scraped on either side, they are returned into pails of fresh water, taken out, stretched, and sewed up all round in manner of bags, leaving out the hinder legs as an aperture for the conveyance of a certain mixture.

The skins thus sewed are put in lukewarm water, where dogs excrement have been dissolved. Here they are stirred with long poles for half an hour, left at rest a dozen, taken out, rinsed in fresh water, and filled by a tunnel with a preparation of water and sumac, mixed and heated over the fire till ready to boil; and, as they are filled, the hind legs are sewed up to stop the passage. In this state they are let down into the vessel of water and sumac, and kept stirring for four hours successively; taken out and heaped on one another; after a little time their sides are changed; and thus they continue an hour and a half, till drained. This done, they are loosened, and filled a second time with the same preparation, sewed up again, and kept stirring two hours, piled up, and drained as before. This process is again repeated, with this difference, that they are now stirred only a quarter of an hour; after which they are left till next morning, when they are taken out, drained on a rack, unsewed, the sumac taken out, folded in two from head to tail, the hair-side outwards, laid over each other on the leg, to perfect their draining, stretched out and dried; then trampled under foot by two and two, stretched on a wooden table, what flesh and sumac remains scraped off, the hair-side rubbed over with oil, and that again with water.

Then they are wrung with the hands, stretched, and pressed tight on the table with an iron instrument like that of a currier, the flesh side uppermost; then turned, and the hair side rubbed strongly over with a handful of rushes, to squeeze out as much of the oil remaining as possible. The first course of black is now laid on the hair side, by means of a lock of hair twisted and steeped in a kind of black dye, prepared of sour beer, wherein pieces of old rusty iron have been thrown. When half dried by hanging in the air, they are stretched on a table, rubbed over every way with a paumelle, or wooden-toothed instrument, to raise the grain, over which is passed a light couche of water, then sleeked by rubbing them with rushes prepared for the purpose. Thus sleeked, they have a second couche of black, then dried, laid on the table, rubbed over with a paumelle of cork, to raise the grain again; and, after a light couche of water, sleeked over anew; and, to raise the grain a third time, a paumelle of wood is used.

After the hair side has received all its preparations, the flesh side is pared with a sharp knife for the purpose; the hair side is strongly rubbed over with a woollen cap, having before given it a gloss with barberries, citron, or orange. The whole is finished by raising the grain lightly, for the last time, with the paumelle of cork; so that they are now fit for the market.

Manner of preparing red Morocco. After steeping, stretching, scraping, beating, and rinsing, as before, they are at length wrung, stretched on the leg, and passed after each other into water, where alum has been dissolved. Thus alumed, they are left to drain till morning, then wrung out, pulled on the leg, and folded from head to tail, the flesh inwards.

In this state they receive their first dye, by passing them after one another into a red liquor, prepared with lac, and some other ingredients, which the maroquineers keep a secret. This they repeat again and again, till the skins have got their first colour; then they are rinsed in clear water, stretched on the leg, and left to drain twelve hours; thrown into water, into which white galls pulverized have been passed through a sieve, and stirred incessantly for a day with long poles; taken out, hung on a bar across the water all night, white against red, and red against white, and in the morning the water stirred up, and the skins returned into it for twenty-four hours.

MOROXYLATES, in chemistry, a genus of salts, of which there are two species, viz. 1. the moroxylate of lime found on the bark of a mulberry-tree, crystallized in short needles. Its taste resembles succinic acid. When heated it swells and emits a vapour

which irritates the organs of smell. Its solution precipitates acetate of lead, nitrate of silver, and nitrate of mercury. 2. M. of ammonia, obtained by pouring carbonate of ammonia into the solution of the moroxylate of lime. This solution, when evaporated, yields crystals of moroxylate of ammonia in long slender prisms.

MOROXYLIC *acid*, discovered a few years since by Dr. Thompson on the bark of the morus alba, or white mulberry, growing at Palermo in Sicily. It coated the bark of the tree in small grains, of a yellowish and blackish brown colour. An account of the analysis of this substance may be found in Nicholson's Journal, vol. vii. This acid has the taste of succinic acid; it is not altered by exposure to the air; it dissolves readily in water and alcohol; it does not precipitate the metallic solutions like its salt. From the small quantity of this acid on which the experiments were made, it appears to be compounded of oxygen, hydrogen, and carbon, but the proportion of the constituent parts is not known. The compounds which it forms with alkalies has received the name of MOROXYLATES. See above.

MORTALITY, *bills of*, registers of the number of deaths or burials in any parish or district. The establishment of bills of mortality in Great Britain, originated in the frequent appearance of the plague, which formerly made great devastations in this country, and an abstract of the number of deaths was published weekly, to shew the increase or decrease of the disorder, that individuals might not be exposed to unfounded alarms, but have some means of judging of the necessity of removal, or of taking other precautions, and government be informed of the propriety or success of any public measures relating to the disorder. Since the disappearance of the plague, these registers have been continued from the convenience found in ascertaining by them the precise time of the birth or death of individuals, and for the information they furnish respecting the rate of human mortality, and the state of population.

The first directions for keeping parish registers of births and burials were given in 1538, when Thomas Cromwell was appointed the King's vicegerent for ecclesiastical jurisdiction, and in that capacity issued certain injunctions to the clergy, one of which ordains, that every officiating minister shall, for every church, keep a book, wherein he shall register every marriage, christening, and burial; and the injunction goes on to direct the manner and time of making the entries in the register book weekly, any neglect of which is made penal. In 1547 all episcopal authority was suspended for a time, while the ecclesiastical visitors then appointed went through the several dioceses to enforce divers injunctions, among which was that respecting parish registers. This injunction was again repeated in the beginning of the reign of Elizabeth, who also appointed a protestation to be made by the clergy, in which, among other things, they promised to keep the register-book in a proper manner. One of the canons of the church of England prescribes very minutely in what manner entries are to be made in the parish registers, and orders an attested copy of the register of each successive year, to be annually transmitted to the bishop of the diocese to be preserved in the bishop's registry. This canon also contains a retrospective clause, appointing that the ancient registers, so far as they could be procured, but especially since the beginning of the reign of Elizabeth, should be copied into a parchment book, to be provided by every parish; which regulation was so well obeyed, that most of the ancient parish registers now extant, commence with that Queen's reign, and some of them earlier, quite as far back as the date of the original injunction.

The London bills of mortality are founded upon the reports of the sworn searchers, who view the body after disease, and deliver their report to the parish clerk. The parish clerks are required, under a penalty for neglect, to make a weekly return of burials, with the age and disease of which the person died, a summary of which account is published weekly; and on the Thursday before Christmas-day, a general account is made up for the whole year. These general accounts of christenings and burials taken by the company of parish clerks of London, were began December 21, 1592; and in 1594 the weekly account was first made public, as also the general or yearly account, until December 18, 1595, when they were discontinued upon the ceasing of the plague; in 1603 they were resumed, and have been regularly continued ever since. The original bills comprehended only 109 parishes, but several others were afterwards included, and in 1660 the bills were new modelled, the twelve parishes in Middlesex and Surry being made a division by themselves, as were likewise the five parishes in

the city and liberties of Westminster. Several other parishes have been added to them at subsequent periods, but many of them have been merely new parishes formed out of larger ones which were before included, and the total number of parishes now comprehended in the London bills of mortality is 146. They are divided into the ninety-seven parishes within the walls, sixteen parishes without the walls, twenty-three out-parishes in Middlesex and Surry, and ten parishes in the city and liberties of Westminster. They give the ages at which the persons die, and a list of the diseases and casualties by which their death was occasioned, but little dependence can be placed on the list of diseases, except with respect to some of the most common and determinate.

These bills would afford the means of ascertaining the state of population with sufficient precision, if the proportion of annual deaths to the number of the living could be accurately determined. This, however, previous to the enumeration of 1801, could not be easily found even in the metropolis, the population of which, as deduced from the bills of mortality was very differently stated by different writers. Mr. John Graunt, who first published observations on the London bills of mortality in the year 1662, made the proportion dying annually about 1 in 27. Sir William Petty and Dr. Brakenridge afterwards stated it as 1 in 30, and Mr. Maitland 1 in 24½, but Dr. Price, who bestowed much attention on this subject, has shewn that about the year 1769, at least 1 in 22¼ of all the inhabitants of London died annually. In fact the proportion appears to have varied considerably at different periods, and of late years, in consequence of the houses being less crowded with inhabitants, the widening of streets, and other improvements, the metropolis has become more healthy, and consequently the proportion dying annually less than formerly. In the "Observations on the results of the Population Act," it is stated that the proportion of annual deaths in London in the year 1750 appears to have been 1 in 25, and in the year 1801 only 1 in 31.

The following statement of the average of each five years from 1730, will shew a considerable decrease in the annual number of burials, and an increase of the christenings, which strongly indicate the progressive increase of the population of the metropolis; the proportion of annual deaths to 100 christenings likewise shews that they have approached so nearly to an equality that the population of London can now nearly support itself without an annual supply from the country.

5 Years ending	Burials	Christenings	Proportion to 100 Christen.
1735 ...	25,490 ...	17,517 ...	145
1740 ...	27,494 ...	16,144 ...	170
1745 ...	25,350 ...	14,419 ...	175
1750 ...	25,352 ...	14,496 ...	174
1755 ...	21,080 ...	15,119 ...	139
1760 ...	19,837 ...	14,459 ...	137
1765 ...	23,992 ...	15,931 ...	150
1770 ...	22,888 ...	16,440 ...	139
1775 ...	22,177 ...	17,284 ...	128
1780 ...	20,743 ...	17,256 ...	120
1785 ...	18,880 ...	17,263 ...	109
1790 ...	19,657 ...	18,465 ...	106
1795 ...	20,228 ...	18,800 ...	107
1800 ...	19,131 ...	18,708 ...	102

The bills of mortality in many parts of Great Britain are known to be materially defective; the deficiencies are ascribed chiefly to the following circumstances. 1. Many congregations of dissenters inhabiting towns have their own peculiar burying grounds; as have likewise the Jews, and the Roman Catholics who reside in London. 2. Some persons, from motives of poverty or convenience, inter their dead without any religious ceremony; this is known to happen in the Metropolis, in Bristol, and Newcastle-upon-Tyne, and may happen in a few other large towns. 3. Children who die before baptism are interred without any religious ceremony, and consequently are not registered. 4. Many persons employed in the army and in navigation die abroad, and consequently their burials remain unregistered. 5. Negligence may be supposed to cause some omissions in the registers, especially in those small benefices where the officiating minister is not resident. Whatever may be the total number of deaths and burials, which from these several circumstances are not brought to account, it has been estimated that about 5000 of them may be attributed to the metropolis, and a large portion of the rest may be ascribed to the other great towns, and to Wales, where the registers are less carefully kept than in England. In Scotland, registers of mortality have not yet been generally established; and those which are kept, are in many instances very incomplete.

The total annual amount of burials, as collected pursuant to the population act,

authorises a satisfactory inference of diminishing mortality in England since the year 1780; the number of marriages and baptisms indicates that the existing population of 1801, was to that of 1780, as 117 to 100, while the amount of registered burials remained stationary during the same period, as will be seen in the following account.

Total number of burials in England and Wales.

Years.	Males.	Females.	Total.
1700	65,752	66,976	132,728
1710	70,606	69,702	140,308
1720	81,156	79,268	160,424
1730	89,085	87,408	176,493
1740	83,706	83,267	166,973
1750	77,149	77,537	154,686
1760	77,750	77,887	155,637
1770	85,952	88,431	174,383
1780	95,845	95,891	191,736
1781	94,505	94,867	189,372
1782	90,189	90,725	180,914
1783	90,606	91,383	181,989
1784	92,851	95,070	187,921
1785	91,548	93,922	185,470
1786	88,330	90,728	179,058
1787	88,123	90,595	178,718
1788	89,227	92,118	181,345
1789	88,411	90,973	179,384
1790	87,954	90,777	178,731
1791	90,895	89,557	180,452
1792	90,963	91,646	182,609
1793	98,560	98,305	196,865
1794	95,511	95,638	191,149
1795	102,086	101,242	203,328
1796	92,289	92,245	184,534
1797	92,292	92,637	184,929
1798	90,657	90,656	181,313
1799	92,078	91,189	183,267
1800	101,686	99,442	201,128

Total number of baptisms and of burials in the twenty-nine years above specified.

	Males.	Females.	Total.
Baptisms	3,285,188	3,150,922	6,436,110
Burials	2,575,762	2,590,082	5,165,844

The proportion of births therefore appears to be 104¼ males to 100 females; of the deaths 99¾ males to 100 females. The average number of burials during the last twenty-one years was about 186,000 per annum.

MORTAR, a preparation of lime and sand mixed up with water, which serves as a cement, and is used by masons and bricklayers in building of walls of stone and brick.

Mortar, when well made, and of the best materials, becomes as hard as stone, and adhering very strongly to the surfaces of the stones which it is employed to cement, the whole wall is as one single stone. To obtain this end the lime should be very pure. Earl Stanhope, who has made many experiments on this substance, found that almost every thing depends upon the burning of the lime; it must be almost vitrified to be completely free from the carbonic acid, and then reduced to fine powder; the sand should be free from clay, and partly in the state of find sand, and partly in that of gravel; the water should be pure, but if saturated with lime so much the better. The best proportions are said to be three parts of fine sand, four of the coarser kind, one part of quicklime, and as little water as may be. The stony consistence of mortar is partly owing to the absorption of carbonic acid, and partly to the combination of part of the water with the lime; hence if to common and well made mortar, one-fourth part of unslacked lime reduced to powder, be added, the mortar when dry acquires much greater solidity than it would otherwise. Morveau has given the following proportions.

Fine sand	30
Cement of well baked bricks	30
Slacked lime	20
Unslacked lime	20
	100

The best mortar for resisting water is made by mixing with lime, puzzolano, a volcanic sand brought from Italy. Basaltes may be substituted in its stead.

Mortar, in chemistry and pharmacy, an utensil very useful for the division of bodies by percussion, trituration, &c. Mortars are of different shapes and sizes, and the matter intended to be broken in them is struck with a pestle made of wood, iron, or marble, according to the different degrees of hardness.

Mortar *piece*, a short piece of ordnance, considerably thick and wide; serving to throw bombs, carcasses, fire-pots, &c.

The use of mortars is thought to be older than that of cannon; they being employed in the wars in Italy to throw stones and balls of red-hot iron, long before the invention of bombs; which, as Blondel informs us, were first thrown at the siege of Wachtendorch, in Guelderland, in 1588.

It was formerly the opinion of gunners, that only one certain charge of powder was requisite for each mortar, and that the horizontal range could not be altered but by changing the direction of the piece; but,

at present, when a place lying in the same horizontal plane with the mortar, is to be bombarded, they elevate the piece to 45°, and augment or diminish the charge of powder until they can hit the mark. The following advantages introduced this practice: 1. The public powder is saved as much as possible; because, at a direction of 45°, a less velocity, and consequently a less charge of powder is required to make any horizontal range, than is necessary to make the same horizontal range at any other elevation. 2. In elevating mortars to their proper directions, gunners seldom come within a degree or two of the proposed elevation, both on account of the imperfection of the instruments which they generally use for that purpose, and the hurry they are in at that time. And in bombarding towns from ships, it is scarce possible to come within two degrees of the designed elevation, because of the agitation of the vessel, which continually changes the direction of the mortar. But by raising the mortar to 45°, the bad consequences of this inaccuracy of elevation are in a great measure prevented, because a small error above or below 45°, occasions a very inconsiderable error of amplitude.

For the same reasons, also, places lying above or below the horizontal plane, passing through the piece, are bombarded by directing the mortar so as its axis may bisect the angle comprehended between a perpendicular to the horizon, at the point of projection, and a line drawn from that point to the mark aimed at; and then augmenting and diminishing the charge of powder until the object be hit.

When the business, therefore, can be effectually done by this middle elevation, it ought certainly to be preferred to any other. However, in the course of a siege it frequently happens, that several of the cases mentioned under the article GUNNERY, are made use of either by the assailants or defendants. Whence we may infer, that though mortars are oftenest, and most fitly, used at 45° elevation, yet they ought not to be founded of one piece with their bed, because such are not only very costly but unwieldy, and therefore unfit to be raised to any desired elevation. See GUNNERY.

Mortars are most fit for service when hung by trunnions and propped with quoins, especially if their carriages be steady enough to prevent the effects of sudden recoiling.

In shooting with mortars, the following general rules should be always observed. 1. To measure the distance of the object aimed at. 2. That the bombs be of equal weight, otherwise the shots will vary. 3. That the carriage be on an exact level, to prevents its leaping. 4. That the powder with which the piece is charged, be always of the same strength and quantity. 5. That the charge be always equally rammed down. 6. That the wads be always of wood, tompions, or oakum. 7. That the fusees be fresh made the days on which they are to be used; and that they be of a composition proportionable to the range of the shot in the air, so that the bomb may break at the very moment of, or soon after its fall; which composition must be such as not to be extinguished though it fall in water, but continue burning till the bomb breaks. See BOMB.

MORTGAGE, signifies a pawn of lands or tenements, or any thing immoveable, laid or bound for money borrowed, to be the creditor's for ever, if the money be not paid at the day agreed upon; the creditor is then called tenant in mortgage, or mortgagee; and the pawner is called the mortgagor. It is called mortgage, because the estate becomes dead and forfeit as to the owner by non payment at the day, and because at strict law, the receipt of the rents and profits by the mortgagor does not go in discharge of the debt. Mortgages are either in fee, or for term of years, and the mortgagor was formerly considered as tenant at will to the mortgagee, but he is now considered to have no legal estate whatever in the land.

The last and best improvement of mortgages is the mode now adopted, where the mortgage is made for a term of years, that the mortgagor if he has also the fee covenants to convey the fee to the mortgagor and his heirs, or any person whom he may appoint, in case of default in payment of the money. This mode unites the advantage of a mortgage in fee and for years. Although after breach of the condition, the estate is absolute at common law in the mortgagee; yet a right of redemption subsists in equity, which is called the equity of redemption, from the benefit of which the heir of the mortgagor cannot be excluded by any covenant, provided the original intent is to mortgage the estate, and not to sell it at first. This right goes to those who would have had the estate if it had not been incumbered. The rule is once a mortgage, and always a mortgage, and even a person who comes in under a voluntary convey-

gagee has the same equity of redemption as the mortgagor. Although therefore the mortgage is forfeited, yet a court of equity will allow the mortgagor at any reasonable time, to recal or redeem the estate, paying the principal, interest, and costs. This however is not allowed if the mortgagee has been twenty years in possession. The heir at law may have the mortgage redeemed out of the personal assets in the first place, as far as they will extend This privilege is also allowed to the person to whom land mortgaged is devised. Where a mortgagor conceals prior incumbrances upon making a second mortgage, he loses the equity of redemption. Stat. 4 and 5 William and Mary, c. 16. Where a mortgage is made, the mortgagee should have the title deeds, as under some circumstances it has been held in equity that a subsequent mortgagee who has the title deeds of the mortgagor shall have a prior claim. A third mortgagee also who buys up the first mortgagee will be preferred to the second, if he had no notice of the second. By stat. 7 Geo. II. c. 20, where an action is brought to recover money due on mortgage, or an ejectment to get into the possession of the lands, if the defendant appears, and within six months pays the debt, interest, and costs, the writ shall be staid. And where a bill is filed in equity by the mortgagee to compel the mortgagor, either to pay off the mortgage, or be foreclosed, or prevented from having his equity of redemption, the like time is allowed, and afterwards the estate is absolutely foreclosed. But the act does not extend to cases where the mortgagor disputes the validity or fairness of the mortgage. By stat. 14 Geo. III. c. 79, sect. 2, estates in the West Indies may be mortgaged here at West India interest. A remainder man may force the tenant in tail to keep down the interest, but not to redeem a mortgage.

MORTMAIN, signifies an alienation of lands and tenements, to any corporation, and their successors, as bishops, parsons, vicars, &c. which is restrained in Magna Charta, and cannot be done without the King's licence. The disposing of property to hospitals is allowed by 39 Eliz. c. 5, and various enactments have been made to prevent the influence of priests and crafty men from taking advantage of the last hours of the lives of weak devotees, by obtaining gifts in mortmain or perpetuity. The chief of these is the stat. 9 Geo. II. c. 36, (called the statute of mortmain) that no manors, lands, tenements, rents, advowsons, or other hereditaments, corporeal, or incorporeal, whatsoever, nor any sum or sums of money, goods, chattels, stocks in the public funds, securities for money, or other personal estate whatsoever, to be laid out or disposed of in the purchase of any lands, tenements, or hereditaments, shall be given, limited, or appointed by will, to any person or persons, bodies politic or corporate, or otherwise, for any estate or interest whatsoever, or any ways charged or incumbered by any person or persons whatsoever, in trust, or for the benefit of any charitable use whatsoever; but such gift shall be by deed, indented, sealed, and delivered in the presence of two or more credible witnesses, twelve calendar months at least, before the death of such donor, and be inrolled in the high Court of Chancery, within six calendar months after execution, and the same to take effect immediately after the execution for the charitable use intended, and be without any power of revocation, reservation, on trust for benefit of the donor. And by the fourth section all gifts or incumbrances otherwise made are void. This act however does not extend to prevent the making bequests, merely of money, to charitable uses, and it is much to be feared that certain fanatics, who are what the monks were formerly, have taken advantage of this, to obtain great bequests of property to improper purposes. In the Evangelical Magazine is published frequently a form of a bequest for the encouragement of Calvinistic Methodism.

MORUS, in botany, *mulberry tree*, a genus of the Monoecia Tetrandria class and order. Natural order of Scabridæ. Urticæ, Jussieu. Essential character: male, calyx four parted; corolla none: female, calyx four leaved; corolla none; styles two; calyx becoming a berry; seed one. There are seven species, of which we shall notice the M. papyrifera, paper mulberry tree. The inhabitants of Japan make paper of the bark; they cultivate the trees for this purpose on the mountains, much after the same manner as osiers are cultivated with us, cutting down the young shoots in December, after the leaves are fallen; these being divided into rods of three feet in length, are gathered into bundles to be boiled, they are placed erect and close in a large copper, properly covered, and the boiling continued till the separation of the bark shews the naked wood, after which, by a longitudinal incision, the bark is stripped off, and

dried, the wood being rejected. To purify the bark, they keep it three or four hours in water; when it is sufficiently softened, the cuticle, which is of a dark colour, together with the greenish surface of the inner bark, is pared of; at the same time the stronger bark is separated from the more tender; the former making the whitest and best paper; the latter a dark and inferior kind.

The finest and whitest cloth, worn by the principal people at Otaheite and in the Sandwich islands, is made of the bark of this tree. The bread-fruit tree makes a cloth inferior in whiteness and softness, worn chiefly by the inferior people. Cloth is also made of a tree resembling the wild fig-tree of the West Indies; it is coarse and harsh, the colour of the darkest brown paper; but it is the most valuable, because it resists the water. This is perfumed, and worn by the chiefs as a morning dress in Otaheite.

MOSAIC. This term is applied to the art of composing figures in imitation of nature and painting, by the judicious arrangement of fragments of marble and coloured glass, inserted in a composition, which becoming hard soon after the operation is completed, renders the subject a durable picture for ages. The learned are doubtful of the origin of the term, which is said by some to be derived from musaicum, which may be supposed to convey an idea of an exceeding curious and difficult representation of natural objects in this way.

It is impossible to ascertain the æra of the invention; but it is by no means improbable that it was suggested by the forming of figures in pavements with different coloured stones or marbles, the durability of which substances, and their resistance of damps, suggested the introduction of imitations of objects on walls and parts of buildings exposed to the action of the weather; those, however, probably were at first very rude and tasteless performances. The Greeks transmitted the art to the Romans: it was perpetuated in Italy, according to the Abbé Barthelemy, during the incursions of the Barbarians, and brought to perfection in Rome in subsequent ages, where the works of the best masters still remain for the admiration of the present and many future generations. The fragments, which are generally of marble, and cut into cubical forms, were distributed with great skill and judgment in the most impervious cement, and being thus firmly connected, the surface received a high polish. The elegance of the work consists in the true disposition of the fragments, their diminutive size, and the richness of the colours: of the latter several of the principal were obtained from the quarries of Sicily and Greece, "at the same time that the different shades were found blended in different species of marble. The whiteness and purity of snow was emulated by the Parian; alabaster, beautifully fair, by that from Synnada, in Phrygia; and unsullied ivory, by a different description from Asia Minor: the marble from Jassus, in Caria, furnished a glowing crimson; and those of Sicily, granites and rubies." The intermediate colours and gradations of colours were supplied by several means, and particularly enamels, as appears from the mosaic works discovered in the Jesuit's college at Frescati, which were conveyed to the cabinet belonging to the order at Rome: in those the blue is a composition or paste; and in one of the pieces are two shades of yellow, one of which is marble, and the other brick.

There are specimens of ancient mosaic, composed exclusively of enamel, and such were those which adorned the floors and walls of a house discovered in the last century at Surrento, and which are attributed to Pollio. Among the pieces preserved at Rome, there were several that agreed with the ideas generally entertained of this laborious and durable species of ornament: but far superior were those valuable fragments found by M. Furietti in Adrian's villa at Tivoli, which he described in a work of great judgment and erudition. One of the pieces alluded to represents four doves, arranged on the rim of a vase, and is equally remarkable for the excellence of the performance, and the connection of the subject with another treated by Sosus, and taken from a house at Pergamus. "The Abbe, observes M. Furietti, is of opinion, that Adrian had caused it to be removed to embellish his house at Tivoli; but may we not as fairly presume, that the Emperor was satisfied with a copy of it? An idea that would solve some difficulties found in the writings of Pliny."

The monument, however, most interesting to antiquaries, was some years past preserved at the palace of the Princes of the Barbarini family at Palestrina, and is the celebrated work in mosaic which in its original destination covered the sanctuary of the temple at Preneste. This magnificent specimen of ancient skill is described by Barthelemy as being about eighteen feet in length, and rather more than fourteen in

breadth, and the attributes of the hunters and animals represented on a mountainous country, in the upper part, left him no reason to doubt that the scene was intended for Egypt. Greek characters inscribed beneath the animals give their names. "In the lower part of the mosaic, we perceive the Nile, winding round several small islands; boats with oars, or sails; Egyptians in pursuit of crocodiles, which conceal themselves among the rushes; rustic cottages; superb buildings; priests performing religious ceremonies in their temples; Egyptian women, reclined under a bower on the borders of a canal, with cups or musical instruments in their hands; and, lastly, a magnificent tent, near which a general, followed by several soldiers, armed with lances and shields, advances towards a female with a palm-branch in her left hand, and in her right a species of garland, which she holds out to him. It was natural," adds this learned writer, "that the sagacity of antiquaries should be employed on so rich a composition. Father Kircher discovered in it the vicissitudes of fortune; Cardinal Polignac, the arrival of Alexander in Egypt; and Father Montfaucon, exhibitions of the Nile, of Egypt, and of Ethiopia." Barthelemy, with more probability, thought it represented the arrival of the Emperor Adrian in a province of Upper Egypt.

Very few, if any, pictures in mosaic have been found in England; but numbers of pavements of Roman origin have often been, and still are continually discovered. Those necessarily differ considerably from the delicate and beautiful works already noticed, and yet the neatness of their component parts, and the elegance of their figures, obtain and deserve admiration. Of more modern performances, there are still a sufficient number remaining in our abbey and cathedral churches, to prove that we have not been deficient in this branch of the arts, although no instances occur of our having adopted this method of decorating walls, which is rather singular, as prudence seems to suggest the propriety of giving stability to the performances of our artists, whose works are subject to constant damps from the humidity of the climate. Of all the pavements in mosaic left in our churches, not one can be compared with that placed by Richard Ware, Abbot of St. Peter's, Westminster, before the high altar of the church, in 1272, which is thus described by Malcolm, in the first volume of "Londinium Redivivum." "The materials are lapis-lazuli, jasper, porphyry, alabaster, Lydian, and serpentine marbles and touchstone. The centre of the design is a large circle, whose centre is a circular plane of porphyry, three spans and a quarter in diameter; round it stars of lapis-lazuli, pea-green, red and white, which being of most beautiful colours, have been subject to depredations; those enclosed by a band of alabaster; and without, a border of lozenges, red and green; the half lozenges contain triangles of the same colours. A dark circle held brass letters, the places of which may be seen; but are now reduced to six: R.E.M.N.T.A The extreme lines of this great circle run into four smaller circles facing the cardinal points: that to the east, a centre of orange and green variegated; round it a circle of green and red wedges; without that, lozenges of the same colours; and completed by a dark border. To the north, the circle has a sexagon centre of variegated grey and yellow; round it a band of porphyry and a dark border. The west circle nearly similar. The south, a black centre within a variegated octagon. A large lozenge incloses all the above circles, which is formed by a double border of olive-colour; within which, on one corner only, are 138 circles intersecting each other, and each made by four oval pieces, inclosing a lozenge. The other parts vary in figure; but would take many pages to describe.

The above lozenge has a circle on each of its sides, to the north-west, south-west, north-east, and south-east. The first contains a sexagon, divided by lozenges of green; within which are forty-one red stars. In the intersections red triangles. Green triangles form a sexagon round every intersection. The second contains a sexagon; within it seven stars of red and green, forming several sexagons, containing yellow stars. The third has a sexagon, formed by intersecting lines into sexagons and triangles; within the former stars of red and green. The latter sixteen smaller triangles of red, green, and yellow. The last a sexagon, with thirty-one within it, filled by stars of six rays, green and yellow. The spaces within the great lozenge round the circles is composed of circles, stars, squares, lozenges, and triangles, the component parts of which are thousands of pieces of the above shapes. The whole of the great lozenge and circles is inclosed by a square, the sides to the cardinal points. It has held other parts of the inscription, of this O and E only remain on the eastern side, N O on the south,

none on the west, and 6 on the north. The four outsides are filled by parallelograms and circles of considerable size, all divided into figures nearly similar to those described."

The above descriptions of mosaic pictures and mosaic pavements will convey a competent idea of the nature of the art. The manner in which they are composed is explained by Keysler, whose accuracy is almost proverbial. According to this valuable author, persons were constantly employed at Rome in making copies in mosaic of those excellent pictures which adorned the walls of St. Peter's church, to replace the latter, as the damps of the building were annually and gradually destroying them. The materials used in his time were small pieces of glass, tinted with different gradations of colours, in the manner of the fine worsted used for needle-work. The glass was cast in thin plates, and afterwards cut into pieces of different lengths and breadths: some of those intended for the composition of figures to be placed on vaults and ceilings were above half an inch in width; but those used for subjects situated near the spectator were formed by pieces not thicker than a common pin, of which two millions are said to be necessary to compose a portrait four feet square. The substance prepared to receive these shreds of glass is a kind of paste, composed of calcined marble, fine sand, gum-tragacanth, the white of eggs, and oil. As some time elapses before the ground hardens, there is no difficulty immediately arising from the act of placing the glass properly, or in removing those which may be found misplaced; but after a certain interval it becomes so extremely solid, that nothing less than violence has any effect upon it. Keysler mentions, that "the paste is first spread in a frame of wood, which must not be less than a foot in breadth and thickness, if the piece be any thing large." The frame is secured by brass nails to a plane of marble or stone; and as some of the most important subjects are twenty feet in length, and fifteen in breadth, an idea may be formed of their very great weight. The fragments of glass are arranged in their proper gradations in cases, which are placed before the artist in the manner that types are set before compositors in printing. The former were so very accurate in imitating the most beautiful strokes of the pencil, that the difference, according to Keysler, seems to consist only in the colours of the copy being more vivid and brilliant than those of the painting. When the copy is completed, they polish them in the same manner usual with mirrors; and after this operation is performed, it is almost impossible to discover that they are composed of an infinite number of fragments, as they rather resemble rich pictures covered with glass. Those pieces intended for distant view are never polished.

The pieces of which mosaic work were originally formed were very large, and sometimes gilded and silvered. About the close of the third century, a Florentine, named Andrea Tasai, contemporary with Cimabue, the restorer of the art of painting, introduced an improved manner of executing it, which soon attracted the attention of the rich and powerful, and in consequence mosaic paintings became much more common than they had been for a long time before. Tasai, however, does not deserve the sole merit of reviving the art, as he acquired his skill from Apollonius, a Greek, who had performed several very fine pieces for St. Mark's church at Venice.

A few specimens of the gilded manner of executing figures in mosaic may still be seen in England, and particularly in Westminster Abbey, where the tombs of Edward the Confessor and of Henry III. have been adorned in this way in fanciful figures, some of which are perfect, but the greater part are destroyed by the silly practice of picking out the fragments of glass, to discover what may be seen on each side—the mode of setting them in the cement. "How much," says Keysler, "this curious art has been improved, during the two last centuries, may be easily seen, by comparing the coarse works in some of the old cupolas of the chapels in St. Peter's church with the other pieces lately erected there. The studs in these old works are made of clay burnt, and the surface only tinctured with various colours."

Another description of mosaic work has been made by the moderns, in the following manner. That wholly of marble is done by preparing a piece of the same material, either white or black. The artist having traced the design upon this plane, he excavates, or cuts, it with a chisel, perhaps to the depth of an inch: other pieces of the colour necessary for the parts are then shaped as correctly as possible to fit the excavations, and set in them with cement. Thus far completed, the artist finishes the shading by drawing intersecting lines with a pencil, and those being cut into the design

as before, they are filled with a black composition, partly consisting of Burgundy pitch, which, when rubbed off, and rendered smooth by polishing, affords an imperfect picture, very greatly inferior to the beautiful works produced in the manner before described, and rather deserving the term of inlaid work than mosaic. There are other methods of imitating this splendid production of art; but with materials that prevents a possibility of deception; indeed their poverty of effect has operated to banish them from the palaces of Europe almost universally.

MOSCHUS, the *musk*, in natural history, a genus of Mammalia of the order Pecora. Generic character: no horns; eight foreteeth in the lower jaw; tusks solitary in the upper jaw exserted. There are six species.

M. moschiferus, or the Tibetian musk, is found in the country from which it takes its name, and also in several provinces of China. Its peculiar perfume was well known to the ancients; but no correct description of the figure of this animal appears to have been published till towards the close of the seventeenth century. It more nearly resembles a roebuck then any other creature. It is about three feet and a quarter long, and about two and a half high. The upper jaw is much longer than the under, and contains two tusks, curved inwards, and sharp on the inner side, about two inches long, and visible when the mouth is shut. The substance of these is very similar to ivory. The musk abounds in the mountainous parts of the countries above mentioned, in the extensive forests of pine trees, and displays extreme agility when pursued by the hunters, bounding from rock to rock with the most elastic energy, and securing itself frequently by its swift progress over rugged and pointed prominences, and by reaching the most elevated and tremendous summits. Musks are valued for food, which, however, at particular seasons of the year, is extremely strong, and to those not used to it scarcely tolerable. But they are principally pursued for the sake of that substance known by the name of musk, and in high estimation as a perfume, and of no little repute also as a medicine, particularly in cases of nervous affection and convulsion. This substance is contained in a tumor attached to the abdomen of the animal, which contains a quantity of soft, unctuous, brownish matter, proportionate to the health and age of the creature from which it is taken. The smell of this substance is most powerful and pungent, and those who make purchases of the article, and in consequence have to compare the quality of various masses of it, are obliged to apply particular precautions, to prevent its overwhelming their senses by its stimulating power. It is not extremely uncommon for a considerable dealer in this article to purchase in one journey seven or eight thousand bags of it, which proves the animals from which it is procured to be extremely numerous. The Tibetian musk is considered as by far the best. This substance is found only in the male.

M. pygmæus, or the Guinea musk, is of a bright bay colour, and only about nine inches in length, of an elegant shape, and such slender legs, that they scarcely exceed the size of a swan's quill. It inhabits many parts of the East Indies, but is most common in the island of Java, the natives of which catch them in snares, and inclosing them in cages, convey them to the markets, where they are sold at very low prices. Their legs are often converted to the purpose of tobacco stoppers, and are ornamented with gold and silver.

M. Americanus, or Brazilian musk, is about the size of a roebuck, and is peculiar to the southern countries of America, particularly Guiana and Brazil. These animals are called by the Indians does, from the circumstance of neither sex possessing horns. They occasionally swim across rivers, and when engaged in these efforts are most easily taken. By land they are active and swift in a very high degree, and so secure and rapid in their progress over projecting rocks, as to occasion the successful hunting of them to be an exercise of no small fatigue and dexterity. Their flesh is in considerable request among the Indians.

MOSQUE, a temple, or place of religious worship, among the Mahometans. All mosques are square buildings, generally built with stone; before the chief gate there is a square court, paved with white marble, and low galleries round it, whose roof is supported by marble pillars. In these galleries the Turks wash themselves before they go into the mosque. In each mosque there is a great number of lamps, and between these hang many crystal rings, ostriches eggs, and other curiosities, which, when the lamps are lighted, make a fine show. As it is not lawful to enter the mosques with shoes or stockings on, the pavements are covered with pieces of stuff sewed together, each being wide enough to hold a row of men sitting, kneeling, or prostrate.

The women are not allowed to enter the mosque, but stay in the porches without. About every mosque there are six high towers, called minarets, each of which has three little open galleries, one above another: these towers, as well as the mosques, are covered with lead, and adorned with gilding and other ornaments; and from thence, instead of a bell, the people are called to prayer by certain officers appointed for that purpose. Most of the mosques have a kind of hospital belonging to them, in which travellers, of what religion soever, are entertained during three days. Each mosque has also a place called Tarbé, which is the burying-place of its founders; within which is a tomb six or seven feet long, covered with green velvet or satin, at the end of which are two tapers, and round it several seats for those who read the koran, and pray for the souls of the deceased.

MOSS. See Musci.

MOTACILLA, the *wagtail*, and the *warbler*, in natural history, a genus of birds of the order Passeres. Though differing somewhat considerably in manners, these birds are ranked by Gmelin under one genus. Generic character: bill subulate and strait; mandibles nearly equal; nostrils small and rather depressed; tongue cloven. Gmelin enumerates one hundred and ninety-four species, of which it will be sufficient to notice the few following.

Of the wagtails it may be observed, that their movements are extremely alert, and that their tails are particularly long, and perpetually jerked up and down by them. Their progress is by running, rather than springing. They rarely perch on trees. Their flight is waving, and accompanied with a twittering sound; and their food consists of flies and other insects, in pursuit of which they will often follow the husbandman with his plough, and also the movements of flocks of sheep.

M. alba, or the pied wagtail, is very common in this country, frequenting the shallow borders of streams and lakes, in search of worms and insects, and often advancing into the water, so as to cause its feet to facilitate its discoveries. Its note is totally uninteresting. It changes its situations in this island from the north to the south, as winter advances. It builds on the ground a warm and well-compacted nest, and the female continues her maternal attentions to her young, for several weeks after they are able to fly, protecting them with great intrepidity, and feeding them with incessant assiduity. See Aves, Plate X. fig. 4.

The warblers are composed of a great variety of classes different in striking particularities of habit as well as in size. They are found in almost all parts of the world, perch on trees, move by leaping, and rarely utter any sounds during their flight. They are more numerous than any genus of birds, and abound principally in the warm latitudes of the globe, where insects, their chief food, are found in never-failing supplies.

M. luscinia, or the nightingale, is somewhat larger than a hedge-sparrow, and, on the upper part of its body of a rusty-brown colour. It is common in several parts of this island; but is seldom seen so far north as Yorkshire, or so much to the west as Cornwall, or even Devonshire. It arrives in April, and quits in August. The males arrive about a week before the females. Their winter residence appears to be unascertained, and never takes place in Great Britain, France, Germany, Greece, or Italy, and is generally supposed to be in Asia, in various parts of which they are found, and highly valued for their powers of melody. In Japan and in Aleppo this is said to be particularly the case. In the latter place they are kept tame, and hired out to give vivacity and harmony to almost every festival and entertainment. In Persia the nightingale sings in great perfection, and Fryer, in his travels through that country, mentioning this bird, says "this sweet harbinger of the light is a constant cheerer of the groves of Persia, charming, with its warbling strains, the heaviest soul into a pleasing ecstasy." By another interesting writer, the nightingale is said to "begin its song with a slow and timid voice; by degrees the sound opens, and swelling, it bursts with loud and vivid flashes; it flows with smooth volubility; it faints and murmurs; it shakes with rapid and violent articulations. The soft breathings of love and joy are poured from the inmost soul, and every heart melts with delicious languor; pauses occasionally occur, to prevent satiety and give dignity and elevation; the mild silence of evening heightens the general effect, and no rival interrupts the happy and interesting scene."

Nightingales build in low and close bushes, and sometimes breed three times in a year. The female sustains the undivided fatigue of incubation, while the male, at a

short distance only, enlivens her with his exquisite strains. Nightingales are never seen even in flocks of a very small number. They live chiefly on insects and berries, on worms and the eggs of ants. They are caught without particular difficulty, having little cunning, though much timidity. Old ones cannot easily be induced to sing in confinement; yet if kept tranquil and unirritated, will at length recur to song, and continue it through a great part of the year as fluently as those which have been reared from the nest. See Aves, Plate X. fig. 4.

M. rubecula, or the redbreast, is found in almost every country of Europe, and, with respect to most, is supposed to be migratory. These birds are never seen in flocks, not even previously to their migration from any country, this being performed by each bird singly. With respect to England, many are known to remain here during the whole year, and, indeed, in winter they are more seen than in the summer, when they have withdrawn to the woods to build their nests and rear their young. In order to keep the nest effectually concealed, it is often covered with vegetable substances, and a narrow entrance only is left to it, under a large collection of leaves. They subsist on insects and worms, which, however, they are observed never to devour alive, and often take great pains to kill before they will swallow them. Their extreme familiarity with mankind has attracted the attention of every age, and bestowed upon them a privileged exemption from that wanton destruction and mischief which are the fate of most of the aerial tribes. They will follow the movements of the hoe or spade in the garden, and in winter will enter the door or window of a habitation, and pick up the fragments that have fallen, as if conscious of security and welcome. The song of this bird, particularly during the incubation of the female, is highly animated and melodious.

M. hippolais, or the pettichaps, conceals itself in the thickest parts of bushwood, and has mimitic powers of very considerable and amusing extent, frequently beginning his varied career of song with the notes of the swallow, and after following it up with numerous intermediate links, terminating with the rich and full song of the blackbird. Though frequently to be heard, it is very rarely seen.

M. atricapilla, or the black-cap, is migratory in England, arriving in April, and withdrawing in September. It feeds not only on insects, but also on various berries, particularly those of ivy. The male takes his share in the labours of incubation, and is highly assiduous also in procuring for the female flies and insects during her term of confinement. Its song is in a great degree similar to the nightingale's, and, when it is exercised in its best stile, for it is sometimes regular and continued, and sometimes abrupt and transient, must be considered superior to that of any of the warblers, the nightingale alone excepted.

M. regulus, or the golden-crested wren, is the smallest of European birds, when stripped of its feathers being not quite an inch long. Its food consists of small worms, several sorts of seeds, insects and their eggs, which last they find plentifully in the fissures of the bark of trees, particularly the oak, to which they seem greatly attached. In a branch of this, or some other tree, it fixes its nest, suspending it by a sort of cord formed of the same materials as the nest itself. The regulus possesses great agility, moving in every direction with perfect ease and unwearied alertness. It bears every latitude, from great heat to very rigorous cold, and is by some much admired for its melody. It remains in England the whole year.

M. œnanthe, or the wheat-ear, visits England about the middle of March, and builds its nest under a clod, in lands which have been recently ploughed. It lives on worms and insects, and is a regular follower of the ploughman in his progress over the field. In some parts of England these birds are taken in vast numbers for the table, two thousand dozen having been taken in snares framed of horse hair, in one season and district only. They are sent to the markets of the metropolis, and sold at the rate of sixpence per dozen. By some they are considered as not inferior to the ortolan.

MOTHER *of pearl* is that beautiful natural white enamel, which forms the greater part of the substance of the oyster shell, particularly of the pearl oyster. See SHELL.

MOTHER *water*, in chemistry, is the uncrystallizable residue of a compound saline solution: thus the liquor left in a salt pan after the salt is taken out, is the mother-water.

MOTION is defined to be the continued and successive change of place. There are three general laws of motion. 1. That a body always perseveres in its state of rest,

or of uniform motion in a right line, till by some external force it be made to change its state; for, as body is passive in receiving its motion, and the direction of its motions, so it retains them, or perseveres in them without any change, till it be acted on by something external. From this law it appears, why we inquire not, in philosophy, concerning the cause of the continuation of motion or rest in bodies, which can be no other than their inertia; but if a motion begin, or if a motion already produced is either accelerated or retarded, or if the direction of the motion is altered, an inquiry into the power or cause that produces this change is a proper subject of philosophy. 2. The second general law of motion is, that the change of motion is proportional to the force impressed, and is produced in the right line in which that force acts. When a fluid acts upon a body, as water or air upon the vanes of a mill, or wind upon the sails of a ship, the acceleration of the motion is not proportional to the whole force of those fluids, but to that part only which is impressed upon the vanes or sails, which depends upon the excess of the velocity of the fluid above the velocity which the vane or sail has already acquired; for, if the velocity of the fluid be only equal to that of the vane or sail, it just keeps up with it, but has no effect either to advance or retard its motion. Regard must always be had to the direction in which the force is impressed, in order to determine the change of motion produced by it: thus, when the wind acts obliquely with respect to the direction of a ship, the change of her motion is first to be estimated in the direction of the force impressed; and thence, by a proper application of mechanical and geometrical principles, the change of the motion of the ship in her own direction is to be deduced. 3. The third general law of motion is, that action and re-action is equal, with opposite directions, and are to be estimated always in the same right line. Body not only never changes its state of itself, but resists, by its inertia, every action that produces a change in its motion: hence when two bodies meet, each endeavours to persevere in its state, and resists any change: the one acquires no new motion, but what the other loses in the same direction; nor does this last lose any force but what the other acquires; and hence, though by their collision, motion passes from the one to the other, yet the sum of their motions, estimated in a given direction, is preserved the same, and is unalterable by their mutual actions upon each other.

All motion may be considered absolutely or relatively. Absolute or real motion, says Mr. Maclaurin, is when a body changes its place in absolute space; and relative motion, is when a body changes its place only with relation to other bodies. From the observation of nature, every one knows that there is motion; that a body in motion perseveres in that state, till, by the action of some power, it is necessitated to change it; that it is not in relative or apparent motion in which it perseveres, in consequence of its inertia, but in real or absolute motion. Thus the apparent diurnal motion of the sun and stars would cease, without the least power or force acting upon them, if the motion of the earth was stopped; and if the apparent motion of any star was destroyed by a contrary motion impressed upon it, the other celestial bodies would still appear to persevere in their course. See Inertia.

To make this matter still plainer, Mr. Martin observes, that space is nothing but an absolute and infinite void, and that the place of a body is that part of the immense void which it takes up or possesses: and this place may be considered absolutely, or in itself, in which case it is called the absolute place of the body; or else with regard to the place of some other body, and then it is called the relative or apparent place of the body.

Now as a motion is only the change of place in bodies, it is evident that it will come under the same distinction of absolute, and relative or apparent. All motion is in itself absolute, or the change of absolute space; but, when the motions of bodies are considered and compared with each other, then are they relative and apparent only: they are relative, as they are compared to each other; and they are apparent only, insomuch that not their true or absolute motion, but the sum or difference of the motions only is perceivable to us.

In comparing the motions of bodies, we may consider them as moving both the same way, or towards contrary parts: in the first case, the difference of motion is only perceived by us; in the latter, the sum of the motions. Thus, for example, suppose two ships, A and B, set sail from the same port upon the same rhumb, and that A sails at the rate of five miles per

hour, and B at the rate of three: here the difference of the velocity (*viz.* two miles per hour) is that by which the ship, A, will appear to go from the ship, B, forwards, or the ship, B, will appear at A to go with the same velocity backwards, to a spectator in either respectively.

If the two ships, A and B, move with the same degree of velocity, then will the difference be nothing, and so neither ship will appear to the other to move at all. Hence it is, that though the earth is continually revolving about its axis, yet, as all objects on its surface partake of the same common motion, they appear not to move at all, but are relatively at rest.

If two ships, A and B, with the degrees of velocity as above, meet each other, the one will appear to the other to move with the sum of both velocities, *viz.* at the rate of eight miles per hour; so that in this case the apparent motion exceeds the true, as in the other it fell short of it. Hence the reason why a person, riding against the wind, finds the force of it much greater than it really is, whereas, if he rides with it, he finds it less.

The reason of all these phenomena of motion will be evident, if we consider we must be absolutely at rest, if we would discern the true or real motions of bodies about us. Thus a person on the strand will observe the ships sailing with their real velocity; a person standing still will experience the true strength and velocity of the wind; and a person placed in the regions between the planets, will view all their true motions, which he cannot otherwise do, because in all other cases the spectator's own motion must be added to, or subtracted from, that of the moving body, and the sum or difference is therefore the apparent or relative motion, and not the true.

Motion is also either equable or accelerated. Equable motion is that by which a body passes over equal spaces in equal times. Accelerated motion is that which is continually augmented or increased, as retarded motion is that which continually decreases; and, if the increase or decrease of motion be equal in equal time, the motion is then said to be equally accelerated or retarded. Equable motion is generated by a single impetus or stroke, thus the motion of a ball from a cannon is produced by the single action of the powder in the first moment, and, therefore, the velocity it first sets out with would always continue the same, were it void of gravity, and to move in an unresisting medium; which, therefore, would be always equable, or such as would carry it through the same length of space in every equal part of time. Hence we may determine the theorems for the expressions of the time (T), the velocity (V), and the space (S), passed over in equable or uniform motion very easily thus:

If the time be given, or remain the same, the space passed over will be as the velocity, *viz.* S : V; that is, with twice the velocity, twice the space; with three times the velocity, three times the space, will be passed over in the same time, and so on.

If the velocity be given, or remain the same, then the space passed over will be as the time, *viz.* S : T; that is, it will be greater or less, as the time is so.

But if neither the time nor velocity be given or known, then will the space be in the compound ratio of both, *viz.* S : T V. Hence, in general, since S : T V, we have V : $\frac{S}{T}$; that is, the velocity is always directly as the space, and inversely as the time. And also T : $\frac{S}{V}$; that is, the time is as the space directly, and as the velocity inversely; or, in other words, it increases with the space, and decreases with the velocity.

If, therefore, in any rectangle, one side represent the time, and the other side the velocity, it is evident that the area of the said rectangle will represent the space passed over by an uniform motion in that time, and with that velocity.

Accelerated motion is produced by a constant impulse of power, which keeps continually acting upon the body, as that of gravity which produces the motion of falling bodies; which sort of motion is constantly accelerated, because gravity every moment adds a new impulse, which generates a new degree of velocity; and, the velocity thus increasing, the motion must be quickened each moment, or fall faster and faster, the lower it falls.

In like manner a body thrown perpendicularly upward, as a ball from a cannon, will have its motion continually retarded, because gravity acts constantly upon it in a direction contrary to that given it by the powder; so that its velocity upwards must be continually diminished, and its motion as continually retarded, till at last it be all destroyed. The body has then attained its utmost height, and is for a moment motionless, after which it begins to descend with a

velocity in the same manner accelerated, till it comes to the earth's surface.

Since the momentum (M) of a body is compounded of the quantity of matter (Q), and the velocity (V), we have this general expression $\mathrm{M} = \mathrm{Q\,V}$, for the force of any body, A; and suppose the force of another body, B, be represented by the same letters in italics, viz. $M = Q\,V$.

Let the two bodies, A and B, in motion, impinge on each other directly; if they tend both the same way, the sum of their motions towards the same part will be $\mathrm{Q\,V} + Q\,V$. But if they tend towards contrary parts, or meet, then the sum of their motions towards the same part will be $\mathrm{Q\,V} - Q\,V$; for since the motion of one of the bodies is contrary to what it was before, it must be connected by a contrary sign. Or thus; because, when the motion of B conspires with that of A, it is added to it; so, when it is contrary, it is subducted from it, and the sum or difference of the absolute motions is the whole relative motion, or that which is made towards the same part. Again, this total motion towards the same parts, is the same both before and after the stroke, in case the two bodies, A and B, impinge on each other; because, whatever change or motion is made in one of those bodies by the stroke, the same is produced in the other body towards the same part; that is, as much as the motion of B is increased or decreased towards the same part by the action of A, just so much is the motion of A diminished or augmented towards the same part by the equal re-action of B, by the third law of motion.

In bodies not elastic, let x be the velocity of the bodies after the stroke (for, since we suppose them not elastic, there can be nothing to separate them after collision; they must therefore both go on together, or with the same celerity). Then the sum of the motions after collision will be $\mathrm{Q}\,x + Q\,x$; whence, if the bodies tend the same way, we have $\mathrm{Q\,V} + Q\,V = \mathrm{Q}\,x + Q\,x$, or if they meet, $\mathrm{Q\,V} - Q\,V = \mathrm{Q}\,x + Q\,x$; and accordingly, $\frac{\mathrm{Q\,V} + Q\,V}{\mathrm{Q} + Q} = x$, or $\frac{\mathrm{Q\,V} - Q\,V}{\mathrm{Q} + Q} = x$.

If the body (B) (Plate XI. Miscel. fig. 1.) be at rest, then $V = o$, and the velocities of the bodies after the stroke will be $\frac{\mathrm{Q\,V}}{\mathrm{Q} + Q} = x$.

Thus if the bodies be equal (viz. $\mathrm{Q} = Q$, fig. 1.) and A with 10 degrees of velocity impinges on B at rest; then $\frac{\mathrm{Q\,V}}{\mathrm{Q} + Q} = \frac{10}{2} = 5 = x$. If $\mathrm{Q} = Q$, and $\mathrm{V} : V :: 10 : 6$, (fig. 2.) we have $\frac{\mathrm{Q\,V} + Q\,V}{\mathrm{Q} + Q} = \frac{16}{2} = 8 = x$, the velocity after the stroke.

If the bodies are both in motion, and tend the contrary way; then when $\mathrm{Q} = Q$ (fig. 3) and $\mathrm{V} = V$, it is plain $\frac{\mathrm{Q\,V} - Q\,V}{\mathrm{Q} + Q} = o = x$; that is the bodies which meet with equal bulks and velocities, will destroy each other's motion after the stroke, and remain at rest. If $\mathrm{Q} = Q$, (fig. 4.) but $\mathrm{V} : V :: 6 : 14$, then $\frac{\mathrm{Q\,V} - Q\,V - 8}{\mathrm{Q} + Q} = \frac{8}{2} = -4 = x$; which shews that equal bodies meeting with unequal velocities, they will, after the stroke, both go on the same way which the most prevalent body moved before.

If the velocity $\frac{\mathrm{Q\,V} \pm Q\,V}{\mathrm{Q} + Q}$ be multiplied by the quantities of matter Q and Q, we shall have $\frac{\mathrm{Q}^2\mathrm{V} \pm \mathrm{Q}\,Q\,V}{\mathrm{Q} + Q} =$ the momentum of A after the stroke; and $\frac{\mathrm{Q\,V}\,Q + Q^2 V}{\mathrm{Q} + Q} =$ the momentum B: therefore $\mathrm{Q\,V} - \frac{\mathrm{Q}^2\mathrm{V} \pm \mathrm{Q}\,Q\,V}{\mathrm{Q} + Q} = \frac{\mathrm{Q}\,Q\,\mathrm{V} \pm \mathrm{Q}\,Q\,V}{\mathrm{Q} + Q} = \frac{\mathrm{Q}\,Q}{\mathrm{Q} + Q} \times \overline{\mathrm{V} \pm V} =$ the quantity of the motion lost in A after the stroke, and consequently is equal to what is gained in B, as may be shewn in the same manner.

But since a part of this expression (viz. $\frac{\mathrm{Q}\,Q}{\mathrm{Q} + Q}$) is constant, the loss of motion will ever be proportional to the other part $\mathrm{V} \pm V$. But this loss or change of motion in either body is the whole effect, and so measures the magnitude or energy of the stroke. Wherefore any two bodies, not elastic, strike each other with a stroke always proportionable to the sum of their velocities ($\mathrm{V} + V$) if they meet, or to the difference of their velocities ($\mathrm{V} - V$) if they tend the same way.

Hence, if one body (B) be at rest before the stroke, then $V = o$; and the magnitude of the stroke will be as V; that is, as the velocity of the moving body A; and not as the square of its velocity, as many philosophers were accustomed to maintain.

In bodies perfectly elastic, the restituent power or spring by which the parts displaced by the stroke restore themselves to their first situation, is equal to the force impres-

sed, because it produces an equal effect; therefore, in this sort of bodies, there is a power of action twice as great as in the former non-elastic bodies, for these bodies not only strike each other by impulse, but likewise by repulse, they always repelling each other after the stroke. But we have shewn that the force with which non-elastic bodies strike each other is as $\mathrm{V} \pm V$; therefore the re-action of elastic bodies is the same; that is, the velocity with which elastic bodies recede from each other after the stroke, is equal to the velocity with which they approached each other before the stroke. Whence if x and y be the velocities of two bodies A and B, tending the same way, after the stroke, since $\mathrm{V} - V = y - x$, we have $x + \overline{\mathrm{V} - V} = y$; whence the motion of A after the stroke will be $\mathrm{Q}x$, and that of B will be $Qx + Q\mathrm{V} - QV$; and the sum of these motions will be equal to the sum of the motions before the stroke, viz. $\mathrm{Q}x + \mathrm{Q}x + Q\mathrm{V} - QV = \mathrm{QV} + QV$. Whence, by reducing the equation, it will be $\mathrm{Q}x + Qx = \mathrm{QV} - Q\mathrm{V} + 2QV$; and $x = \frac{\mathrm{QV} - Q\mathrm{V} + 2QV}{\mathrm{Q} + Q}$ = the velocity of the body A.

Again, the velocity of B is $x + \mathrm{V} - V = \frac{\mathrm{QV} - Q\mathrm{V} + 2QV}{\mathrm{Q} + Q} + \mathrm{V} - V = \frac{2\mathrm{QV} - \mathrm{Q}V + QV}{\mathrm{Q} + Q}$. Here we suppose the bodies tend the same way before the stroke; and it is evident from the equation above, that so long as $\mathrm{QV} + 2QV$ is greater than $Q\mathrm{V}$, the velocity (x) of A after the stroke will be affirmative, or the body A will move the same way after the stroke as before; but when $Q\mathrm{V}$ is greater than $\mathrm{QV} + 2VQ$, the velocity (x) will be negative, or the body A will be reflected back.

If the body B be at rest, then $V = o$; and $x = \frac{\mathrm{QV} - Q\mathrm{V}}{\mathrm{Q} + Q}$, which shews the body A will go forwards or backwards, as QV is greater or lesser than QV, or A greater or lesser than B.

If $\mathrm{Q} = 3$, $Q = 2$, $\mathrm{V} = 10$, (fig. 5.) and $V = o$; then after the stroke the velocity of A will be $x = \frac{\mathrm{QV} - Q\mathrm{V}}{\mathrm{Q} + Q} = \frac{30 - 20}{5} = \frac{10}{5} = 2$, and the velocity of B will be $y = \frac{2\mathrm{QV}}{\mathrm{Q} + Q} = \frac{60}{5} = 12$. If the bodies are both in motion, and $V = 5$, the rest is the same as before; then $\frac{\mathrm{QV} - Q\mathrm{V} + 2QV}{\mathrm{Q} + Q} = 6$ = velocity of A (fig. 6.) after the stroke, and $\frac{2\mathrm{QV} - \mathrm{Q}V + QV}{\mathrm{Q} + Q} = 11$ = velocity of B after the stroke.

If the bodies A and B move towards contrary parts, or meet each other, then will the relative velocity, to which the force of the stroke is proportional, be $\mathrm{V} + V$; and so the velocities of A and B after the stroke will be x and $\dot{x} + \mathrm{V} + V$; and so the motion of A will be $\mathrm{Q}x$ and $Qx + Q\mathrm{V} + QV$; the sum of these motions is $\mathrm{Q}x + Qx + Q\mathrm{V} + QV = \mathrm{QV} - QV$ = the motion towards the same part before the stroke. Whence we have $x = \frac{\mathrm{QV} - Q\mathrm{V} - 2QV}{\mathrm{Q} + Q}$, and therefore the velocity of B will be $\frac{\mathrm{QV} - Q\mathrm{V} - 2QV}{\mathrm{Q} + Q} + \mathrm{V} + V \frac{2\mathrm{QV} = \mathrm{Q}V - QV}{\mathrm{Q} + Q}$.

If $Q\mathrm{V} + 2QV$ be greater than QV, the motion of the body A will be backwards; otherwise it will go on forwards as before.

If $\mathrm{Q} = 3$, $Q = 2$, $\mathrm{V} = 10$, and $V = 5$; then will the velocity of A (fig. 7.) be $\frac{\mathrm{QV} - Q\mathrm{V} - 2QV}{\mathrm{Q} + Q} = \frac{-10}{5} = -2$, and so the body A will go back with two degrees of velocity. The velocity of B, after the stroke, will be $\frac{2\mathrm{QV} + \mathrm{Q}V - QV}{\mathrm{Q} + Q} = 13$.

If the bodies are equal, that is, if $\mathrm{Q} = Q$, (fig. 8.) then $x = \frac{-2QV}{2Q} = -V$; which shews, that when equal bodies meet each other, they are reflected back with interchanged velocities; for in that case also the velocity of B becomes $\frac{2\mathrm{QV}}{2\mathrm{Q}} = \mathrm{V}$.

If the bodies are equal, and one of them at rest, as B (fig. 9.) then since $\mathrm{Q} = Q$, and $V = o$, we have the velocity of A after the stroke $x = o$; or the body A will abide at rest, and the velocity of B will be $= \mathrm{V}$, the velocity of A before the impulse, as appears by the example in the figure referred to.

If several bodies, B, C, D, E, F, (fig. 10.) are contiguous in a right line, and another equal body A strike B with any given velocity, it shall lose all its motion, or be quiescent after the stroke; the body B which receives it will communicate it to C, and C to D, and D to E, and E to F; and because action and re-action between the bodies B, C, D, E, are equal, as they were quiescent

before, they must continue so; but the body F, having no other body to re-act upon it, has nothing to obstruct its motion; it will, therefore, move on with the same velocity which A had at first, because it has all the motion of A, and the same quantity of matter by hypothesis.

Let there be three bodies, A, B, C, (fig. 11.) and let A strike B at rest; the velocity generated in B by the stroke will be $y = \frac{2\mathrm{QV}}{\mathrm{Q}+Q}$, and so the momentum of B will be $\frac{2\mathrm{QV}Q}{\mathrm{Q}+Q} = Qy$. With this momentum B will strike C at rest and contiguous to it; the velocity generated in C will be $\frac{2Qy}{Q+\mathrm{C}}$; and its momentum will be $\frac{2Qy\mathrm{C}}{Q+\mathrm{C}} = \frac{2Q\mathrm{C}}{Q+\mathrm{C}} \times \frac{2\mathrm{QV}}{\mathrm{Q}+Q} = \frac{4\mathrm{QV}Q\mathrm{C}}{\mathrm{Q}Q+\mathrm{QC}+Q^2+Q\mathrm{C}}$.

If now we suppose B a variable quantity, while A and C remain the same, we shall find what proportion it must have to each of them, in order that the momentum of C may be a maximum, or the greatest possible, by putting the fluxion thereof equal to nothing; that is, $\frac{4\mathrm{Q}^2\mathrm{C}^2\mathrm{V}\dot{Q} - 4\mathrm{QC}Q^2\dot{Q}}{\overline{\mathrm{QC}+\mathrm{Q}Q+Q\mathrm{C}+Q^2}|^2} = 0$; whence we get $\mathrm{QC} - QQ = 0$, and so $\mathrm{QC} = QQ$; consequently $\mathrm{Q} : Q :: Q : \mathrm{C}$, or A : B :: B : C; that is, the body B is a geometrical mean between A and C. Hence if there be any number (n) of bodies in a geometrical ratio (r) to each other, and the first be A; the second will be r A, the third r^2 A, and so on to the last, which will be r^{n-1} A.

Also, the velocity of the first being V, that of the second will be $\frac{2\mathrm{V}}{1+r}$ (for $\frac{2\mathrm{QV}}{\mathrm{Q}+Q}$ is here $= \frac{2\mathrm{AV}}{\mathrm{A}+r\mathrm{A}} = \frac{2\mathrm{V}}{1+r}$); that of the third $\frac{4\mathrm{V}}{\overline{1+r}|^2}$, that of the fourth $\frac{8\mathrm{V}}{\overline{1+r}|^3}$, and so on to the last, which will be $\overline{\frac{2}{1+r}}|^{n-1}\mathrm{V}$.

The momentum of the first will be AV, that of the second $\frac{2r\mathrm{AV}}{1+r}$, that of the third $\frac{4r^2\mathrm{AV}}{\overline{1+r}|^2}$, that of the fourth $\frac{8r^3\mathrm{AV}}{\overline{1+r}|^3}$, and so on to the last, which will be $\overline{\frac{2r}{1+r}}|^{n-1}\mathrm{AV}$.

To give an example of this theorem; if $n = 100$, and $r = 2$, then will the first body A be the last r^{n-1} A, as 1 to 338253000000000000000000000000, nearly; and its velocity to that of the last nearly as 2710220000000000000 to 1: lastly, the momentum of the first to that of the last will be nearly as 1 to 233848000000.

If the number (n) of bodies be required, and the ratio of the momenta of the first and last be given as 1 to M, and the ratio of the series r given also; then, putting $\frac{2r}{1+r} = \mathrm{R}$, we have the momentum of the last body expressed by $\overline{\frac{2r}{1+r}}|^{n-1} = \mathrm{M} = \mathrm{R}^{n-1}$; therefore the logarithm of M ($l.$ M) is equal to the logarithm of R ($l.$ R) multiplied by the power $n-1$; that is, $l.\,\mathrm{M} = \overline{n-1} \times l.\,\mathrm{R}$; consequently $\frac{l.\,\mathrm{M}}{l.\,\mathrm{R}} + 1 = n$, the number of bodies required.

Motion, in botany, implies not so much a change of place as a change of direction. The direction of the roots and stems of plants is totally opposite, the former either running directly downwards, or extending themselves transversely or horizontally under the surface of the earth: the latter exhibiting motions of a similar nature, but in a contrary direction. The direction of the root is never vertical, except in the manar of Senegal, the roots of which twisting, rise vertically upwards a foot above the surface of the earth, and are sometimes covered by the flux of the sea. Familiar as the appearance is, naturalists are not agreed with respect to the causes which determine the roots of plants to tend universally downwards, either in a horizontal or perpendicular direction; and the stems, on the contrary, to mount perpendicularly or horizontally upwards. So constant, however, are these opposite directions, that a plant being taken out of the earth, and replanted in it in such a manner that the root is uppermost, and the stem lowermost; the root will quickly curve downwards, the stem upwards, till each has resumed the direction which is proper and natural to itself.

All the causes which concur in promoting the growth of plants appear likewise to operate in determining their direction. Such are the air, the sun, light, and the moist warm vapours which arise out of the earth. The three first seem to concur most certainly to the direction of the stem; air and moisture to that of the root. If any number of plants are placed in pots, in a room which only admits the light by a single hole, the stems will incline or direct themselves towards that side. In thick forests, the young trees always lean to the side where

the light penetrates. The new shoots of an espalier detach themselves from the wall which robs them of the air, the sun, and the light. It is in quest of the same excellent gifts of nature, that the lateral branches of trees abandoning the direction of the stem, spread and extend themselves in a direction parallel to the soil, even when planted on a declivity. In like manner it appears, that the roots penetrate more or less deeply into the ground, either in a perpendicular or horizontal direction, in proportion to their greater or less tendency to search for moisture. Thus it is a well known fact, that, in the neighbourhood of canals, ditches filled with water, and ground newly tilled, the roots of plants abandon their natural direction, and as it were, steer their course towards the fine air, rich juices, and grateful humidity, which their situation has placed within their reach. So strongly, indeed, are the roots of plants attracted by water, that they frequently relinquish the soil, and penetrate into the very heart of ditches and canals. This force of extension appears to be greater in roots than in stems. The branch surmounts an obstacle, by leaving its natural direction and over-topping it. The root, on the contrary, without once going out of its way, pierces the hardest soils, penetrates into walls, which it overturns, and even into rocks, which it bursts.

Although the natural motion of the trunk be to ascend, as was suggested above, yet is it forced oftentimes to descend; for the trunk-roots growing out of some plants near the ground, and shrinking into it, serve, like so many ropes, to pluck the trunk annually lower and lower into the ground, along with them. If these trunk-roots break out only about the bottom of the trunk, then it gradually descends into the earth, and is converted into a root, but if the trunk is very slender, and the trunk-roots break forth all along it, then it creeps horizontally; the trunk-roots in question tethering it, as it trails along, to the ground, as in strawberry, cinquefoil, and mint. It may be observed, that the direction of the roots and stems of plants seems to be regulated, in a great measure, by the vapours which they contain, but more by those which arise from the soil in which they grow; and, that heat, the sun, or the light, the causes already suggested, appear to contribute to that direction, only in so far as they augment or regulate the current of these nourishing vapours.

Trunks are not, however, the only parts of plants which direct their course towards the air and the light of the sun. There are flowers which, quitting their perpendicular direction, present their surface directly to that luminous body, and follow its situation in its diurnal course. This sort of motion has been called, by some writers, nutation; and the plants which are subject to it, have been termed heliotropæ; that is, turning with the sun. Of this kind are bastard-rocket, dyer's-weed, sun-flower, turnsole, and the greatest part of the compound flowers with plain tongue-shaped petals. In these flowers, the disk or surface looks towards the east in the morning, the south at noon, and the west at night. The spikes or ears of corn, which hang down by their weight, are observed, in like manner, to incline themselves towards the sun, never to the north. The stems of draba, trientalis, and a species of bastard fever-few with egg-shaped and notched leaves, incline or hang downwards during the night.

The observations of Hales, and Bonnet, establish, that these motions are occasioned not by any twisting in the stem, but by the dryness of the fibres, which, by being exposed to the heat of the sun, contract, and thus determine the nutation of the flowers and young stems. It is in this manner that moisture and dryness alternately dilate and contract the plant improperly called the rose of Jericho; an appearance which is likewise observed in the beards of oats, and in those of the capsules of crane's bill.

The direction of the leaves of several plants suffer considerable changes during the night. This is so certain, that if a botanist who is accustomed to the part or habit of plants, were to examine, in a summer night, the plants which cover any particular meadow, he would find several which he could not recognize by that character. The same changes happen when the moisture of the day corresponds to that of the night.

The change of direction just mentioned is particularly sensible in compound leaves. During the heat of the sun in the day-time, the pinnated or winged leaves of several plants, particularly those of the pea-bloom or leguminous tribe, rise vertically upwards, and form a right angle with the common foot-stalk; the lobes, or lesser leaves, which stand opposite, being applied closely together by their upper surface. Several simple leaves, particularly those of sigesbecka, and Indian mallow, (urena) when their upper surface is exposed to an ardent sun, become, in like manner, concave; which demonstrates their analogy with the winged leaves just mentioned.

In that state of the atmosphere which generally precedes a storm, and in a close, moist, and cloudy air, the winged leaves extend themselves along the common foot-stalk. The same appearance is observed in the leaves of the sensitive plant, when it has been kept for several days in a cellar below ground. After sun-set, and during the fall of the dew, they incline still lower, hang vertically downwards, and are applied closely together, like the leaves of a book, by the lower surface under the stalk, with which they stand at right angles. The odd lobe, if there is one at the extremity of the leaf, folds itself up till it has reached the first pair of lobes, or smaller leaves, in its neighbourhood. This motion, which Linnæus calls the sleep of plants, and can be produced by an artificial as well as natural dew, has been observed not only in compound leaves, such as those of the pea-bloom plants, but likewise in some simple leaves, particularly those of balsam, and bastard fever-few. The small leaves of false acacia and liquorice hang downwards during the night, but are not united by the under surface, like the greater part of leguminous plants. Those of the sensitive plant, mimosa pudica, extend themselves longitudinally along the common foot-stalk, and infold one another mutually. The small lobes of several species of trefoil, lucerne, and lotus, are united only by their summits, and form a cavity which contains the young flowers, and shelters them from cold and other injuries to which they are liable in the night-time. In some simple leaves, a similar appearance is observed. Thus the upper leaves of garden orach approach during the night, unite perpendicularly, embrace the young shoot, and do not relinquish that posture till the sun has dissipated the humidity of the air. See Milne's excellent Botanical Dictionary, to which we have been indebted for these observations.

MOTION, *perpetual*, or MOVEMENT. See MOVEMENT.

MOTTO, in armoury, a short sentence or phrase carried in a scroll, generally under, but sometimes over the arms; sometimes alluding to the bearing, sometimes to the name of the bearer, and sometimes containing whatever pleases the fancy of the deviser. The motto, or word, says Guillim, is an ornament annexed to coat-armour; being the invention or conceit of the bearer succinctly and significantly expressed, usually in three or four words, which are commonly set in some scroll or compartment, placed at the foot of the escutcheon. Our ancestors made choice of such mottos as expressed their predominant passions, as of piety, love, war, &c. or some extraordinary adventure that had befallen them; most of which have become hereditary in several families. The motto of the royal family of England is DIEU ET MON DROIT, *God and my right*; of the most noble order of the garter, HONI SOIT QUI MAL Y PENSE, *Evil be to him that evil thinks;* of the Dukes of Norfolk, SOLA VIRTUS INVICTA, *Only virtue is invincible;* of the Duke of Beaufort, MUTARE VEL TIMERE SPERNO, *I scorn to change or fear;* of the Marquis of Buckingham, TEMPLA QUAM DILECTA, *How beloved are thy temples*, in allusion to his name of Temple.

MOVEABLE, in general, denotes any thing capable of being moved. The moveable feasts are such as are not regularly held on the same day of the year or month, though they are always on the same day of the week. Thus Easter, which is that moveable feast on which all the rest depend, is held on the Sunday which falls upon, or next after, the first full moon following the 21st of March; and all the other feasts keep a regular and certain distance from it: such as Septuagesima, Sexagesima, Ash-wednesday, Ascension-day, &c. which see under their proper articles. The moveable terms are Easter-term, and Trinity-term.

MOVEMENT, in mechanics, a machine that is moved by clock-work. See CLOCK.

MOVEMENT, in military affairs. Under this term are comprehended all the different evolutions, marches, countermarches and manœuvres, which are made in tactics for the purpose of retreating from, or of approaching towards an enemy. It also includes the various dispositions which take place in pitching a camp, or arranging a line of battle. The science of military movements forms one of the principal features in the character of a great commander. If he be full of resources in this important branch, he may oftentimes defeat an enemy without even coming to blows; for to conceal one's movements requires great art and much ingenuity.

MOVEMENT, in music, the name given to any single strain, or to any part of a composition comprehended under the same measure, or time. When any piece changes its time and measure, either from one species to another, or in the same species, it is then said to change its movement; so that

every composition consists of as many movements as there are positive changes in the time or measure. See MUSIC.

MOVING *plant*. See HEDYSARUM.

MOULD, or MOLD, in the mechanic arts, &c. a cavity cut with a design to give its form or impression to some softer matter applied therein, of great use in sculpture, foundery, &c. The workmen employed in melting the mineral or metallic glebe dug out of mines, have each their several moulds to receive the melted metal as it comes out of the furnace; but these are different according to the diversity of metals and works. In gold-mines they have moulds for ingots; in silver-mines, for bars; in copper and lead mines, for pigs or salmons; in tin mines, for pigs and ingots; and in iron-mines, for saws, chimney-backs, anvils, cauldrons, pots, and other large utensils and merchandizes of iron, which are here cast as it were at first hand.

MOULDS, in the manufacture of paper, are little frames composed of several brass or iron-wires, fastened together by another wire still finer. Each mould is of the bigness of the sheet of paper to be made, and has a rim or ledge of wood to which the wires are fastened; these moulds are more usually called frames, or forms.

MOULDS *for leaden bullets*, are little iron-pincers, each of whose branches terminates in an hemispherical concavity, which when shut, form an intire sphere; in the lips or sides where the branches meet, is a little jet or hole through which the melted lead is conveyed.

MOULDS, *glazier's*. The glaziers have two kinds of moulds, both serving to cast their lead. In the one they cast the lead into long rods or canes fit to be drawn through the vice, and the grooves formed therein; this they sometimes call ingot-mould. In the other they mould those little pieces of lead a line thick, and two lines broad, fastened to the iron-bars; these may be also cast in the vice.

MOULDS, among plumbers, are the tables whereon they cast the sheets of lead. These they sometimes call simple tables; besides which they have other real moulds wherewith they cast pipes without soldering.

MOULDS, used in basket-making are very simple, consisting ordinarily of a willow, or osier, turned or bent into an oval, circle, square, or other figure, according to the baskets, panniers, hampers, hats, and other utensils intended. On these moulds they make or more properly measure all their work, and accordingly they have them of all sizes, shapes, &c.

MOULDS, among tallow-chandlers, are of two kinds; the first for the common dipped candles, being the vessel wherein the melted tallow is disposed, and the wick dipped; this is of wood, of a triangular form, and supported on one of its angles, so that it has an opening of near a foot at top; the other, used in the fabric of mould candles, is of brass, pewter, or tin; here each candle has its several moulds. See CANDLE.

MOULD, among gold-beaters, a certain number of leaves of vellum, or pieces of guts, cut square, of a certain size, and laid over one another, between which they put the leaves of gold and silver, which they beat on the marble with the hammer. They have four kinds of moulds, two whereof are of vellum, and two of gut; the smallest of those of vellum consists of forty or fifty leaves, the largest contains an hundred; for the others, each contains five hundred leaves. The moulds have all their several cases, consisting of two pieces of parchment, serving to keep the leaves of the mould in their place, and prevent their being disordered in beating.

MOULD, in agriculture, a loose kind of earth, every where obvious on the surface of the ground, called also natural or mother-earth; by some also loam.

MOULDINESS, a term applied to bodies which corrupt in the air, from some hidden principle of humidity therein; and whose corruption shews itself by a certain white down, or lanugo, on their surface, which, viewed through a microscope, appears like a kind of meadow, out of which arise herbs and flowers, some only in the bud, others full blown, and others decayed, each having its root, stalk, and other parts.

MOULDING, any thing cast in a mould, or that seems to have been so, though in reality it were cut with a chisel, or the ax.

MOULDINGS, in architecture, projectures beyond the naked wall, column, wainscot, &c. the assemblage of which forms cornices, door-cases, and other decorations of architecture.

MOUNTAINS, stupendous elevations of earth and other substances, in some cases coeval with creation, and in others the produce of subterraneous motion caused by fire and confined vapours.

The methods used to ascertain the heights

of mountains are necessarily imperfect, as their pyramidal outline uniformly prevents the dropping of a plummet, the only certain mode of accurate measurement. Before the invention of the instruments now employed for this purpose, which undoubtedly approach very nearly to certainty in their result, recourse was had to conjecture, and the erroneous practice of measuring their shadows. Strabo, judging from the means possessed in his time, declared the highest mountain in the world to be equal to 21,830 English feet. Kircher, deciding from the length of their shadows, pronounced

Ætna	25,600
The Peak of Teneriffe	64,000
Mount Athos	128,000
And Larissa in Egypt	179,200

M. Bourrit, who explored the Alps, gives the following table of the various elevations of places and mountains above the level of the sea.

	English yards.
The Lake of Geneva, at the lower passage of the Rhone	398
The Lake of Neufchatel	456
Highest point of the Needle of Saleve	1488
Summit of Canigou	3088
Summit of Dole, the highest mountain of Jura	1800
Summit of Mole	2014
Valley of Chamouni	1121
Ridge of Breven	2949
Valley of Montanvert	1865
Abbey of Sixt	797
Granges des Communes	1769
Highest Grange of Fonds	1458
Summit of Grenier	2782
Summit of Grenairon	2958
Plain de Lechaud	2295
Summit of Buet	3315
Mont Blanc	5081
Mount Ætna	4000
Summit of the Table at the Cape of Good Hope	1153
Summit of Snowdon in Wales	1224
Pike Rucco in the island of Madeira	1689
Pike of Teneriffe	4399
The same according to Dr. Heberden	5132
Summit of Cotopaxi according to Ulloa	6643

Some philosophers have estimated the Peak of Teneriffe to be 19,200 feet in height; Feuille reduces it to 13,248; and others assert that the Peak and Ætna are the most elevated objects on the earth. But this supposition has been combated by Sir George Shuckborough, who measured Ætna from an observation by M. de Saussure, and found it to be 10,954 feet above the level of the sea. The latter gentleman had obtained the height of Vesuvius, and Sir George measured Mont Blanc; from which it appears, that the height of Vesuvius added to that of Ætna is 14,854 feet, and that of Mont Blanc alone amounts to 15,662 feet; whence he infers, that Mont Blanc far eclipses all other mountains in Europe, Asia, and Africa; those of America, according to Condamine, are of vast height, and in some instances the elevation amounts to 19,200 feet.

Upon comparing the calculations of different persons in their attempts to measure these enormous masses, it will be found that they vary greatly; it is therefore obvious, that the methods at present in use are subject to impediments, which are attributable to many causes: some of those may hereafter be removed, but there are others so completely connected with local circumstances of heat, cold, moisture, and the reverse, that it is impossible they should ever be overcome; neither is it quite correct to infer, that the chain of the Caucasus, the Taurus, and the African mountains, are inferior to Mont Blanc, unless the same opportunities were afforded for measuring their heights which exist in Europe. Mr. Coxe says, "Conjectures are now banished from natural philosophy; and until it shall be proved from undoubted calculations, that the highest part of the Caucasus rises more than 15,000 feet above the level of the sea, Mont Blanc may be fairly considered as more elevated." This position rests on very slender grounds indeed, and resembling the conjectures said to be banished from natural philosophy, it should be rejected without hesitation. In truth, this point will most probably never be satisfactorily adjusted; and we must rest satisfied with the knowledge we have already acquired, till reason or philosophy shall have taught, or extended civilization throughout the globe, and future naturalists have made measurements of hitherto unexplored mountains, with instruments similar to those used by Saussure and Shuckborough.

There are numerous and serious obstacles opposed to the ascertaining of the nature of the substances which compose the great

mass or internal structure of mountains, but every thing has been done which art and perseverance will permit. M. Arduini, a gentleman of strong abilities and indefatigable research, exerted every means in his power some years past to obtain a knowledge of the interior state of the Vicentine and Veronese hills, which he divides into *montes primarios, secundarios,* and *tertiarios.*

The *montes primarios* is a vast body of slate, extending under the calcareous hills, which he concludes existed prior to their origin.

The *montes secundarios* are large calcareous hills formed into strata, composed of a close impalpable limestone, and interspersed with marine petrifactions, similar to parts of the Alps, and the chain of mountains which separate Germany from Italy.

Montes tertiarios are the lower hills, consisting of small beds of limestone, abounding with petrifactions, and with casual interventions of sand and clay, but are of a later origin, since incumbent on the "montes secundarios," and produced by their decay, variously washed down and accumulated together.

The slate of the first division is argillaceous, containing micaceous particles of the colour of silver, is crossed by veins of quartz, lamellated, and often appears in waved strata. It extends to the greatest depth of any rock in the neighbourhood, and has never been cut through, from which circumstance it cannot be decided whether granite extends beneath it, as is usual in other mountainous countries, "though this be very probable," says Ferber, "since the granite rocks appear from under ground in the higher Alps of Tyrol, and the grey granite, or granitello, is to be found near Tomino and Primiero, at the spring of the river Cismonoe, which falls into the Brenta."

The calcareous Alps consist of strata of a close impalpable grain, with little mixture of silicie matter and petrifactions. The deepest stratum of limestone from the base to the middle of the hill is composed of numerous small masses, and the exterior being subject to the action of rain-water, it is formed into chasms, leaving the intervals in elevations of a dark lead-colour; the petrifactions scattered through it are small bivalves and rifled tellines. The next stratum is inconsiderable, but a better white, more solid, and serves for architectural purposes, the upper part contains no petrifactions, the lower has some unknown ostracites. The third stratum is in many small beds, in some instances furnishing sea-shells, and in others destitute of petrifactions. The part connected with the fourth stratum consists of oolithes. The fourth stratum is composed of several smaller, which are either red, containing ammonites of very considerable size, or completely white with petrifactions or ammonites. The red Veronese marble abounding with ammonites, is procured from this stratum. The fifth division consists of an infinite variety of beds of white limestone, those in the highest mountains, particularly Monte Torraro, contain no marine productions, but the rest abound with various, each stratum being filled with a peculiar species. The surfaces of these Alps on the summits is called scaglia by the Italians, and consists of a calcareous bed, in some parts containing nodules, and in others less extensive, numerous flints of various colours. Covering the mountains it declines under the Montes Tertiarios Bericos, and ascends on the opposite side to the volcanic hills, by the sides of which it appears to have been raised, and then broken. The scaglia is destroyed in many different places by the weather, and is only to be found in a perfect state in the vallies and cavities. M. Arduini discovered red flints, branching like coral, in the scaglia of Monte di S. Pancrazio, and that spread on the volcanic hills near Padua, is perforated by sulphurous hot wells.

The several strata of the hills or mountains in question have been originally disposed in an horizontal direction, but those are deranged, and broken into large fissures by the force of volcanic eruptions and earthquakes, through which lavas were ejected, consequently they are sunk in some places, in others wholly reversed, and sometimes they are found oblique, and even vertical. Inundations, and the obstructions of the course of rivers, caused by the above means, have also operated to produce many changes which are particularly conspicuous at Ayorth, in Valle Imperina. The fields near Gallio, Asiago, Campo di Rivere, &c. situated on the mountains far above the level of the sea, are strewed with vast numbers of separate fragments of granite, quartz, and other vein-rocks, which appear to have been detached by violence from the primitive mountains of Tyrol. Similar pieces are found on the same horizontal elevation in Feltrino, separated by the Brenta

from the others, and westward on the same heights from Astico to the river Adige. Their number and variety of bulk is remarkable at Tonezza, and near Folgaria, where the hills being entirely calcareous, entirely destitute of sound and primitive strata, demonstrate that the fragments alluded to are foreign to the places in which they are deposited. As no possible movement of water could, in the nature of things, be supposed to elevate these masses, it is equally fair to suppose, that streams gushing down the mountains have carried them to their present situations, from those vast ruptures observable in every direction on mountains, doubtlessly caused, in the first instance, by earthquakes filling the usual channels of great bodies of water.

The calcareous portion contains numbers of natural caverns, incrustated with stalactites, and some veins of metal which are neither large nor extensive, but cross the compact limestone in the under stratum, being invariably inserted in the fissures next to the adjoining inferior slate and its metallic veins, to which they appear to belong, and the cracks of the solid limestone, into which volcanic matter has been forced, sometimes contain metals. Generally no ore or veins are discoverable in the highest stratum of the calcareous mountains which are lamellated and shiver. The ancient silver mines in Monte di S. Catharina, in Tretto, pass through the undermost compact limestone; and in Monte di Trisa, Monte Narro, Monte di Castello di Pieve, and several others to the west, are veins and old mines of silver, copper-ore, and lead, with pyrites, manganese, and blend, which extend through limestone. In Monte Sivellina is hard limestone without visible stratum, petrifactions, a lead vein, coarse tessilated lime-spar, manganese, and amethysts.

The last division, "montes tertiarios," or lower hills, were in some degree produced by the decay of the higher, and accumulations of sand and clay: those have regular strata, and various petrifactions, and particularly nummularios and lenticularios. They have suffered great derangement from volcanic causes, which is demonstrated by the discovery of large fragments of limestones, petrifactions, and other substances, inclosed by the lava, and raised by its flowing upward, and they have often been covered by the descent of ashes. Some are considered as posterior to the eruptions, and rest on their productions, when these are found to contain pieces of lava, or pumice stone, it is conjectured that they have been introduced by the passage of water. Several of these hills in the Vicentine, Veronese, and other districts of the Venetian territories, contain strata of coal, which inclose some petrifactions, particularly a fish found at Monte Viale in the first-mentioned district. Very little ore has been discovered; and Ferber, to whom we are indebted for these observations, was at a loss whether to class certain sandy and argillaceous hills in the Valle di Signori with those under consideration, as the latter contain coals, plaster, alabaster, sulphurous pyrites, with some lead, copper, and iron ore.

Many of the hills in the Vicentine and Veronese districts furnish numerous and beautiful petrifactions; of those the Montes Berici, near Vicenza, are most remarkable. Creazzo, three miles from Vicenza, contains the inner nuclei or impressions of Chamites, almost perfect pectinites, the arca Noæ, the chitos Linnei, and some scarce glossopetras, and the sand abounds with fragments of madrepores, small nautilites, and uncommon teeth of fish. I. Colli di Montecchio e Castel Gomberto is full of petrifactions, and the lowest explored stratum of Brendola, ten miles from Vicenza, is a blue clay, interspersed with surprising quantities of marine bodies, and is covered by numbers of limestone beds, dipping towards the sea, including a great variety of sea shells, but unlike those contained in the clay. The west side of the hill is covered with lava, generally striated, and formed like sherl. The fissure in the lava, called *le spesse*, has a rivulet in the bottom, which flows over ground containing an astonishing quantity of madrepores, fungites, and exotic shells, the aggregate affording a most pleasing assemblage of marine and volcanic productions. Ostracites are found very plentiful at St. Vido, and at Gramona are petrified echinites, and the echinus orbiculus, which inhabits the Indian seas in its natural state. Besides those, there are serpula lumbricalis; and at one hundred yards distance nummularii, and non-descript balani. An isolated hill, called Favourita, in the Vicentine district, contained the bones and teeth of a crocodile, discovered by M. Arduini. Ronca seems to be the production of the united powers of Neptune and Vulcan; but the interior is in a state of utter confusion and devastation; the summit is completely volcanic and without pe-

[illegible], beneath are calcareous beds, which have [illegible], [illegible], and [illegible], [illegible] lower is a mass of black lava, hard and broken in small fragments, nearly of an angulated prismatical form: after which red clay or marle, mixed with petrifactions, occurs; then lava, pumice stone, breccia, or limestones, inserted in lava, and beds of limestone, with petrifactions. Ronca affords plenty of ostracites of different species, and in good preservation, murices, anomiæ, and bones; the species amount to thirty; those are found in the calcareous strata, and in the volcanic sand and ashes which, coagulated with limestones, have produced a species of breccia.

It has been judged necessary to dwell on the discoveries made as to the internal formation of the above hills, as their size and situation enable the curious investigator to accomplish his wishes; and as the information thus obtained must be accepted in place of facts, in relation to the stupendous mountains to be noticed hereafter in this article; those defy the labours of the philosopher, who is compelled to creep along their craggy and forbidding sides, attentive to his own safety, rather than their properties, and to conjecture the internal state from external appearance.

Ferber says, the island Elba is remarkable on account of its iron-mines, the mountains of which consist of granite generally of a violet colour and very fine, as the feldspath lies in large oblong cubes of the above tint. The ore is not found in veins, but in an enormous mass surrounded by the mountains of granite, it is besides a fact, that several mountains in Sweden, Lapland, and Siberia wholly consist of iron-ore; and some hills in Campiglia, and other places in Tuscany, are either entirely, or in a great measure, of the same nature.

Further particulars of the probable contents of mountains in other parts of the globe will be found as we proceed in this investigation, but it will next be necessary to mention the changes observable in the state of the atmosphere by those who have ascended to the summits of the highest portions of our earth; several attempts had been made to attain the most elevated points of Mont Blanc by the guides of Chamonny, and by Messrs. de Saussure and Bourrit, the first undertaken by the guides was on the 13th of July 1776, when three of them accompanied by M. Couteran departed from the Priory, at some distance from the mountain, at eleven in the night, these persons passed through the interval between the glaciers of Bosson and Tacona, and were fourteen hours employed in ascending a most rugged way, crossing extensive vallies of ice, and plains of snow, before they reached the vast elevation opposite to Mont Blanc which then appeared as if very near them, but on a more attentive examination of the relative situation of the places they found they had been deceived by the clearness of the air, and the brightness of the snow, and that it would require at least four hours of additional exertion to reach the summit, which they considered impracticable for many reasons, and particularly as the clouds gathered on the sides of the mountain and threatened a tempest; they therefore returned with precipitation, which had nearly been fatal to one of the party, who in leaping over a chasm in the ice, slipped and fell into it, but fortunately retaining his grasp of the pole with which he performed the spring, and that falling across the chasm, he was extricated by his companions; the man fainted and remained insensible for some time, but they reached Chamonny without further accident after twenty-two hours of incessant labour. Sir George Shuckborough calculated that they had attained the height of 13,000 feet above the level of the Mediterranean Sea.

The failure of this arduous undertaking discouraged other attempts for some years, and till M. Bourrit prevailed upon six guides to accompany him on September 11th, 1784, this gentleman pursued his journey with great ardour and enthusiasm, but was arrested in his progress by the intenseness of the cold, which compelled him to return, the guides were less affected, and two that had preceded the rest reached the dome of Goute situated about 9,100 feet in a horizontal direction from the summit. On the fourth of September in the following year Marie Contet and James Lambat ascended to a great height, and passed the night under the shelter of a rock, advancing with the dawn of day they reached the dome just mentioned about seven o'clock, and would have proceeded with every prospect of success, had not a dreadful storm of hail rendered further exertion impracticable.

On the 13th of September the same year Messieurs de Saussure and Bourrit, and twelve guides, bearing a variety of instruments intended for observations, left Bionsay, and after some time arrived at a hut

which they had ordered to be constructed at Pierre Ronde, 7,808 feet above the level of the sea; they passed the night at this uncomfortable elevation, and proceeding in the morning, they reached the hitherto decided boundary of research, the dome of Gouté, there a fresh fall of snow lay in so great a depth as to prevent the possibility of wading through it, and the party returned. M. de Saussure imagined he had ascended to 8,256 English feet, and he found that the barometer sunk eighteen inches and a half. The guides, those hardy sons of the Alps, were not deterred by the hardships endured on these occasions, and six once more entered upon an unsuccessful ascent in July 1786; James Balma, a young man of great strength and possessed of an excellent constitution, one of the number, having missed his way in wandering upon the ice, was under the necessity of passing the night on a spot above the dome, this he accomplished in safety, and in the morning he had the resolution to examine the mountain, in order to ascertain whether a more favourable path might not be discovered for ascending on any future occasion; the result was according to his wishes, and he descended to Chamouny without accident, where he was afflicted with a very severe indisposition, the united effects of extreme cold and fatigue, Dr. Paccard, a resident physician, attended Balma during his illness, to whom he related his observations on the practicability of ascending Mont Blanc, and offered to attend him on his recovery as a mark of gratitude for that event; Paccard inspired by the hope of performing a task not hitherto accomplished accepted the proposal, and they departed from Chamouny on the 7th of August, they reached La Cote before dark, and passed the night there, at three the following morning they recommenced their dangerous excursion, ascended to the dome of Gouté, and at length arrived on the ridge of rocks seen from Geneva on the left of the summit; when there the cold became almost intolerable, and their fatigue was such that Paccard was inclined to return, but Balma encouraging him by example and persuasion, he followed the courageous guide, each walking sideways to avoid, as much as possible, the piercing effect of the wind, at six in the evening they accomplished their wishes, and stood with triumph on a pinnacle never before visited by man; they remained half an hour on the summit exposed to a degree of cold which froze the provisions they carried in their pockets, and the ink in their inkhorns. The difficulties of descending were almost as considerable as those they experienced in the ascent, but they returned to Chamouny without any other unpleasant occurrence than blistered faces, swelled lips, and eyes injured by the brilliancy of the snow.

M. de Saussure determined to follow this successful example, hired eighteen guides, provided a tent, matrasses, philosophical instruments and provisions, and left Chamouny to ascend to the summit of Mount Blanc on the 13th of August 1787. In order to render their expedition as safe and comfortable as the nature of it would permit, he had the precaution to have a hut constructed on La Cote, where the party passed the first night; by four o'clock in the afternoon of the following day they had ascended 12,762 feet above the level of the sea, and at that vast elevation they excavated a hut in the frozen snow, which they covered with a tent, in this they regaled themselves as well as they could, but M. de Saussure found the heat of the place so excessive, that he was frequently obliged to leave it to recover from the debility and suffocation he experienced; at seven o'clock the next morning the party proceeded on their enterprize, and at eleven they reached the object of their hopes the top of the mountain; there, lost in wonder and admiration at the variety and extent of the view on every side, this adventurous band remained three hours and an half during which time they did not experience that extremity of cold felt by Dr. Paccard and his companion.

M. de Saussure pursuing his intentions with that sagacity and method that distinguishes the genuine philosopher, had stationed M. Senebier at Geneva who made similar experiments in that city at the same moment that the former was employed on Mont Blanc, by these means he found, that at Geneva, Reaumur's thermometer stood at 22,6 or 82 of Fahrenheit's, and on the mountain in the shade at 2 $\frac{1}{10}$ below the freezing point of the former, or 27 of the latter, a difference of 45 degrees by Fahrenheit. De Luc's barometer when on the mountain fell to 16.0 $\frac{14}{16}$, and at Geneva it stood at 27.2 $\frac{10}{16}$; and by making experiments with the same instrument, he calculated that the spot on which he made them was 15,662 feet above the level of the sea, agreeing almost exactly with the amount ascertained by Sir George Shuckburgh.

The hygrometer evinced, that the air surrounding the summit contained six times less humidity than that of Geneva, to which cause he ascribed an excessive thirst experienced by himself and the rest of the party, who were all more or less affected by the rarefaction of the air. The balls of the electrometer diverged three lines, and the electricity was positive on this enormous mountain; the most elevated rocks of which are granite, where M. de Saussure found at 11,392 feet from the sea, the moss-campion in bloom, and still higher the lichen sulphurens, and lichen rupestris; and, what was a greater object of astonishment, two butterflies hovering near the summit.

Such was the result of M. de Saussure's labours, to which we shall add, in the words of Mr. Coxe, the following interesting facts derived from Friar Francis one of the monks resident at the priory at St. Gothard. "About four years ago the Elector of Bavaria sent to the friar several barometers, thermometers, and other meteorological instruments, which has enabled him to note the variations of the atmosphere, and to form a series of observations, of which he favoured me with the following result. In the most extreme cold he ever experienced in these parts, the mercury in Reaumur's thermometer fell to 19 degrees below the freezing point, or 10 of Farenheit. In 1784, greatest heat on the 13th of September, it stood at 15, or $61\frac{1}{2}$ of Farenheit; greatest cold at 17°, or $8\frac{1}{2}$° of Fahrenheit.

M. de Luc's barometer never rose higher than..............	22	3	1
Or fell lower than.........	20	9	9

It appeared from observations made in 1784, that the average state of the thermometer and barometer was as follows:

	Thermometer.	Barometer.		
Nine in the morning	$2\frac{1}{16}$ of Reaumur, or 28° of Fahrenheit......	21	9	2
Mid-day	......0..................... or 32°......................	21	9	3
Nine in the afternoon	1 — 3 lines, ... or $29\frac{1}{2}$.......................	21	9	4

In the same year it snowed during some part of 118 days; rained, 78; cloudy, 293; tempest, with hail, 12; thunder and lightning, 22; rainbow, 4; halo's round the sun, 2; and round the moon, 2; serene days, 87."

Some particulars have been collected relating to the formation of the Alps, from which it appears, that granite constitutes their basis; large portions of this substance are scattered in the vallies near them, detached by different causes, and conveyed to very considerable distances by their weight; many dreadful consequences have followed the sudden separation of vast masses, of which two instances may be mentioned that are calculated to excite the utmost horror. Plurs, a town containing 1500 inhabitants, three churches, and situated on the Maira, was overwelmed on the 25th of August 1618, by the fall of part of a mountain, which was suspended in dreadful majesty above it, and in one moment, for ever obliterated from the surface of the earth. A cloud of dust of impenetrable gloom pointed out to the survivors where the town had stood, and the cause of its ruin, as the enormous fragments of stone rushing with inconceivable rapidity through the air, were ground into powder where their sides met in collision with others; and had any of the miserable residents escaped the crush of their habitation, suffocation must have terminated their existence. Houses, vineyards, and large trees now cover the ruins of Plurs, and bones, and various utensils are casually discovered in digging.

On the 2d of September 1806, and at five o'clock in the evening, the summit of Mount Rosenberg, generally called the Knippenouhl rock, separated from the adjoining parts, and fell to the base, which was situated in the valley that divides the lake of Zug from Lauwertz. One fragment rushed into the lake of the last named place, and caused a vast wave, which flowing impetuously on the opposite shore, washed down a considerable number of houses, places of worship, and mills. Besides the loss thus occasioned by the lake, the earth and rocks levelled the villages of Goldau, Rothen, Busingen, and Knzlock, containing in the whole above three hundred habitations. Upon inquiry it was found that 1000 persons had lost their lives by this sudden disruption of the mountain, which might have been less calamitous in its consequences had the prediction of General Pfiffer been attended to, who having made a model of the Alps, was well acquainted with the part under notice, and foresaw that it must be detached from its situation at no very distant period. It is generally

supposed that the rock fell into a gulph made by a large body of water which descended beneath it, and gradually undermined its support, and turning, by its superincumbent weight, scattered into large portions, by striking on the projections in its progress, till reaching the plain it is now said to cover a space of very great extent, and above 100 feet in height.

Mr. Coxe endeavoured to ascertain the component parts of the Alps, and to accomplish his purpose wished to penetrate towards the chains of granite, through avenues of tremendous rocks, but found that the approach to it was equally difficult and dangerous caused by the interposition of high secondary mountains, which conceal the primitive bed of granite, particularly in the vale of Lauterbrunnin, bounded to the extremity by calcareous rocks; the first masses of granite he discovered were at Sichellanen forming the base of the rocks just mentioned; proceeding, he observed a rock of steatite containing veins of lead, which have been worked at Hohalp; at a greater ascent, is the true chain of granite, with scattered calcareous peaks; the approach was less difficult at Wengenalp, the last of several calcareous and schistous mountains, which join the Jungfrau, appearing to have summits of granite. Calcareous stone and argillaceous schistus form the vale of Grindelwald; and the surfaces of the Eger, the Mettenberg, and of the Wetterhorn, are chiefly calcareous, and cover the granite. The chains opposite, forming the north side of the valley of Grindelwald, consists of an argillaceous base, interspersed with cornua ammones, and is covered by calcareous rocks.

In the further pursuit of his survey, Mr. Coxe considered the Jungfrau, or virgin, the centre of the primitive chain, which is one of the most grand and highest mountains in the canton of Berne: the lowest part of this elevated mass is generally covered with staldenfluh, or rocks of calcareous stone, but the granite doth not appear for a considerable distance up the sides; at Sichellaninen, he observed a red stratum composed of an argillaceous slate spotted with green and brown, and of a fine grained iron-ore containing anomites, which appeared to form the separation between the calcareous substance and the granite, a similar stratum was discoverable in other places, but at inaccessible heights, the same cause prevented the investigation in the chain extending to the right, and several peaks furnish no other means of judging of their structure than fragments afford which have fallen from them; limestone occurs at a great elevation, and white and grey marble serving as the matrix of a red hematite, abounding with small octagon crystals of iron, which may be attracted by the magnet. The glaciers of Breitlaninen and Breithorn support fragments of several species of granite, of iron-stone, of saxum fornacum or stelstein, and of argillaceous and micaceous schistus. "The ridge of the glacier of Gamchi is of a black calcareous stone, which, in many places, is of a fine texture, and splits into lamina of a rhomboidal form; in other parts it is coarsely granulated, containing white and black spar." Black slate forms the sides of the Blumlis Alp which fronts the glacier; this substance contains balemnites, and cornua ammonis, and the broken pieces of granite lying upon the glacier, fallen probably from the summit, resembles that before-mentioned containing lead. The chain of granite extending to the right by the Alpschelenhorn and the Altits, are lost in Mount Gemmi, where slate and calcareous stone alone are found. On the other side of the Jungfrau, are two vast pyramids, called the interior and exterior Egers, on those calcareous stone is visible to a great height, and Mr. Coxe was convinced that their substance is granite, though covered by calcareous stone, lying on slate of a reddish colour, forming in many places a species of brescia, with an argillaceous base, strewed with calcarous fragments; stones which have fallen from a ridge behind the exterior Eger, on the inferior glacier of Grindenwald, prove that the summit is of granite, in blocks, veined granite, and other lamellated rocks, which frequently contain green steatites, amianthus, and crystals of quartz. The Schreckhorn, or peak of terror, has piked summits rising to an amazing height, which appear to be pure granite, and other primitive stones; the Wetterhorn, or stormy peak, is of calcareous stone for a great height, but the summits are certainly primitive rocks. Mr. C. observed the red stratum which he had noticed before on the Eger, and at the base of the Jungfrau. Behind the Wetterhorn is a large rock, the stones detached from which are frequently found to be veined granite and lamellated rock, enclosing pieces of the corneus spathosus, interspersed with steatites, pyrites and quartz. A quarry of beautiful white marble veined with green, red, and yellow, was formerly

washed at the foot of the Wetterhorn, but it has since been covered by the inferior glacier. The Scheidek consists intirely of black slate, which continues to compose the chain that divides Grindelwald from the plains of Hasli and the lake of Brientz. Mr. Coxe concludes his interesting observations in the following words, "As I descended the Scheidek, I observed on my right hand, the chain that joins the Wetterhorn, and runs towards the Grimsel. As I have not particularly examined this chain, I shall only remark, in general, that from an investigation of the stones and fragments which strew the vallies and sides of the hills, it appears to contain the same species of marble, which I found on the superior glacier of Grindelwald, also red slate, argillaceous brescia, and various granites. But thus much is certain, that the front of these mountains is intirely concealed by secondary substances; and that the true region of granite was not apparent, until I had passed Meyringen, and ascended the Grimsel, during the greatest part of which ascent, I only noticed lamellated rocks and granite. This is the true region of granite, and other primitive rocks, the heart of the central chain, and the great observatory of the naturalist."

It is vain to think of entering into an examination of the various peculiarities of the stupendous mountains which extend in every direction throughout the explored surface of our globe, we shall therefore confine ourselves to one other chain, from which, and what has previously been said, a tolerable conception may be formed of those grand and sublime objects, the admiration of each generation from the hour of creation to the present moment.

The Atlas is an extensive chain, forming a crescent across the empire of Morocco, nearly from the north to the south, the northern extremity reaching to the Straights of Gibraltar. They are intersected by deep vallies, and distinguished by the names of the Greater and Lesser Atlas. Their height is very great, and particularly near the city of Morocco, where, although situated so far to the south, their summits are perpetually covered with snow. The difficulty attending the exploration of the country, has hitherto repressed the curiosity of the philosopher, who would meet with little respect from the natives, and probably a summary fate through the despotism of the government; under these circumstances we are compelled to receive casual information instead of philosophical certainty, and to adopt as fact what might perhaps on examination prove mere conjecture or misinformation, such may be the assertion, that the cold on the summits is fatal to animal life, as it is said certain Brebes, who attempted to ascend the Atlas, died on the spot. These mountains abound with curious plants, well worth the attention of botanists; and it is further asserted, that they contain gold, and plenty of iron-ore, and that part of the chain is volcanic. Mr. Lempriere, who crossed the Atlas in December 1790, observes, "on the upper parts, in some places, there was nothing to be seen but an huge mass of barren and rugged rocks, whose perpendicular and immense heights formed precipices, which, upon looking down, filled the mind with inexpressible horror; in others, we passed through thick and extensive forests of the arga tree, which, though it afforded an agreeable variety, being the only vegetable on the mountains, very little lessened the general appearance of barrenness. It is by no means a very easy matter to describe the different sensations which are experienced in passing over these wonderful mountains. Their immense height, the dangerous precipices, the vales, which from their depth appeared like so many abysses, inspired altogether an emotion of awe and terror, which may be better conceived than expressed. On the other hand, the unlimited and great variety of prospects discoverable from their summits; the numerous herds of goats and sheep which were scrambling over the almost perpendicular cliffs, and the universal barrenness of the mountains, contrasted with the beautiful verdure of the vallies immediately below, formed on the whole a scene sufficiently beautiful and picturesque, to counterbalance the inconveniences we otherwise suffered."

MOUSE. See Mus.

MOUTH, in anatomy, a part of the face, consisting of the lips, the gums, the insides of the cheeks, the palate, the salival glands, the os hyoides, the uvula, and the tonsils. See ANATOMY.

MUCILAGE, in chemistry, is contained in the roots and leaves of a great number of plants. Almost all the bulbous roots and fleshy leaves yield it. The bulbs of the hyacinth contains so much, that when dried, they may be employed as a substitute for gum-arabic. See GUM. Mucilage is sometimes found nearly pure, exuding from the bark and twigs of many vegetables, and

hardening in the sun into brittle and almost transparent lumps.

MUCUS, a mucilaginous liquor separated by the mucous glands, and the nostrils.

MUCUS. See PHYSIOLOGY. The chemical properties of this substance are; that it has the appearance of gum arabic, only more opaque; it does not dissolve in alcohol or ether; it does not coagulate when heated; it is not precipitated by the oxymuriate of mercury, nor by the infusion of galls; the acetate of lead occasions a copious white precipitate when dropped into solutions containing mucus; so does the nitrate of silver. It is generally combined with gelatine and albumen, and always with some of the salts, and on the whole it is one of the least abundant of the animal fluids. In its natural state it is generally colourless, but from peculiar causes it will frequently assume a thick consistence and whitish colour like pus. From some experiments made by the late Dr. Charles Darwin, certain important conclusions have been drawn, for which the reader is referred to MEDICINE.

MUFFLE, in metallurgy, an arched cover, resisting the strongest fire, and made to be placed over coppels and tests in the operations of assaying, to preserve them from the falling of coals and ashes into them; though, at the same time, of such a form, as is no hindrance to the action of the air and fire on the metal, nor to the inspection of the assayer. The muffles may be made of any form, providing they have these conditions; but those used with coppels are commonly made semi-cylindrical; or when greater vessels are employed, in form of a hollow hemisphere. The muffle must have holes, that the assayer may look in; and the fore part of it must be always quite open, that the air may act better in conjunction with the fire, and be incessantly renewed; the apertures in the muffle serve also for the regimen of the fire, for the cold air rushing into the large opening before, cools the bodies in the vessel; but if some coals are put in it, and its aperture before be then shut, with a door fitted to it, the fire will be increased to the highest degree, much more quickly than it can be by the breathing holes of the furnace. See ASSAYING.

MUGIL, the *mullet*, in natural history, a genus of fishes of the order Abdominales. Generic character: lips membranaceous, the lower one carinated inwards; no teeth; above the corners of the mouth an inflected callous substance; gill-membrane with seven curved rays; body fleshy and whitish; large scales; two dorsal fins. Gmelin notices only five species. Shaw mentions nine. M. cephalus, or the common mullet is generally about fourteen inches in length, and is found not only in the Northern and Mediterranean Seas, but in the Indian and Western Oceans. These fishes collect in vast multitudes almost close to the shores, in quest of those aquatic insects which constitute their food, thrusting their heads into the soft muddy bottoms with incessant activity. On the approach of summer they assemble in immense numbers to ascend rivers, which they do to a considerable distance from the sea, in order to deposit their ova, and while they are thus assembled, the fishermen avail themselves of the transient opportunity, and, spreading their nets take them in extraordinary abundance. They are regarded by many as excellent, but are not often seen at the tables of the opulent.

MUHLENBERGIA, in botany, a genus of the Triandria Digynia class and order. Natural order of Gramina, Gramineæ, or Grasses. Essential character: calyx one-valved, minute, lateral; corolla two-valved. There is but one species, *viz.* M. diffusa, which is a perennial grass, and a native of North America.

MULBERRY. See MORUS.

MULE, in zoology, a mongrel kind of quadruped, usually generated between an ass and a mare, and sometimes between a horse and a she-ass. The mule is a sort of a monster, of a middle nature between its parents, and therefore incapable of propagating its species; so careful is nature to avoid filling the world with monsters. Mules are chiefly used in countries where there are rocky and stony roads, as about the Alps, Pyrenees, &c. Great numbers of them are kept in these places; they are usually black, strong, well limbed, and large, being mostly bred out of the fine Spanish mares; the mules are sometimes fifteen or sixteen hands high. No creatures are so proper for carrying large burdens, and none so sure footed. They are much stronger for draught than horses, and are often as thick-set as our dray-horses; and they will travel several months together, with six or eight hundred weight upon their backs; they are much hardier and stronger than horses, and will live and work twice the age of a horse. Those mules which are light are fitter for riding than horses, as to the walk and trot; but they are apt to gallop very roughly. See EQUUS.

MULLER, or MULLAR, denotes a stone flat and even at the bottom, but round at top, used for grinding of matters on a marble. The apothecaries use mullers to prepare some of their testaceous powders, and painters for their colours, either dry or in oil. Muller is also an instrument used by the glass-grinders; being a piece of wood, to one end whereof is cemented the glass to be ground. It is ordinarily about six inches long, turned round.

MULLERA, in botany, so named in memory of Otho Frederick Muller, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ. Leguminosæ, Jussieu. Essential character: pericarpium elongated, fleshy, necklace form, with one seeded globules. There is only one species, viz. M. moniliformis, a native of Surinam.

MULLET, or MOLLET, in heraldry, a bearing in form of a flat, or rather of the rowel of a spur, which it originally represented. The mullet has but five points; when there are six it is called a star; though others make this difference, that the mullet is, or ought to be always pierced, which a star is not.

MULLUS, the *surmullet*, in natural history, a genus of fishes of the order Thoracici. Generic character: head compressed and scaly; mouth bearded; gill-membrane, with three rays; body round, long, and red, coated with large and easily deciduous scales. There are six species according to Gmelin. Shaw reckons thirteen. The M. rubea, or red surmullet, is the fish which was one of the favourite delicacies of Roman epicurism, and which, when particularly scarce, might be sold for its weight in silver coin. Its colours are a rose red, olive and silver, exquisitely blended, and, in a dying state, the surmullet exhibits those rapid and contrasted changes which have often been described as particularly attending the expiring dolphin. From this circumstance this fish was considered, among the Romans, as exhibiting a feast to the eye as well as the palate. Before it was delivered over to the cook, it was displayed in a transparent vase to the company assembled, and considered as affording a most interesting spectacle, by those rapid changes of colour which accompanied its expiring struggles, sometimes glowing with intense ardour, then fading into deathful pallidness. It is found in the Mediterranean and in the North Seas, and is about fourteen inches long.

MULTANGULAR, a figure, or body, which has many angles.

MULTILATERAL, in geometry, is applied to those figures which have more than four sides or angles, more usually called polygons.

MULTINOMIAL, or *multinomial roots*, in mathematics, such roots as are composed of many names, parts, or members; as $a + b + d + c$, &c. See ROOT.

MULTIPLE, in arithmetic, a number which comprehends some other several times, thus 6 is a multiple of 2, and 12 is a multiple of 6, 4, and 3, comprehending the first twice, the second thrice, &c.

MULTIPLE *ratio*, or *proportion*, is that which is between multiples. If the lesser term of the ratio be an aliquot part of the greater, the ratio of the greater to the less is called multiple; and that of the less to the greater submultiple. A submultiple number is that contained in the multiple: thus, the numbers 1, 2, and 3, are submultiples of 9. Duple, triple, &c. ratios, as also subduples, subtriples, &c. are so many species of multiple and submultiple ratios.

MULTIPLICAND, in arithmetic, one of the factors in the rule of multiplication; being that number which is given to be multiplied by another, which is called the multiplicator, or multiplier.

MULTIPLICATION, in general, the act of increasing the number of any thing. See ARITHMETIC and ALGEBRA.

MULTIPLICATION, *cross*, otherwise called duodecimal arithmetic, is an expeditious method of multiplying things of several species, or denominations, by others likewise of different species, &c. *e. g.* Shillings and pence, by shillings and pence; feet and inches, by feet and inches.

This is much used in measuring, &c. and the method is thus:

Suppose 5 feet 3 inches to be multiplied by 2 feet 4 inches; say 2 times 5 feet is 10 feet, and 2 times 3 is 6 inches: again, say 4 times 5 is 20 inches, or 1 foot 8 inches; and 4 times 3 is 12 parts, or 1 inch: the whole sum makes 12 feet 3 inches. In the same manner you may manage shillings and pence, &c.

Ft	In.
5	3
2	4
10	6
1	8
	1
12	3

MULTIPLYING *glass*, in optics, one wherein objects appear increased in number. It is otherwise called a polyhedron, being ground into several planes, that make angles with each other; through which the rays of light issuing from the same point undergo different refractions, so as to enter the eye from every surface in a different direction.

MULTISILIQUÆ, in botany, the name of the twenty sixth order in Linnæus's "Fragments of a Natural Method;" consisting of plants which have more seed vessels than one. Of this kind are aconitum, monk's hood; delphinium, larkspur; nigella, or devil-in-a-bush; and many others. These plants are mostly perennial herbs: the stems of some are erect, others creep on the ground, and produce roots near the origin of each leaf, as in some species of ranunculus; others climb, and attach themselves to the bodies in their neighbourhood, either by the foot-stalk of their leaves, as the virgin's bower, or by tendrils which terminate the foot-stalk, as atragene. The flowers are hermaphrodite, and are easily rendered double by culture. The calyx is wanting in some; in the others it is generally composed of five pieces, which fall with the petals; but the calyx of the rue and peony is permanent. The petals vary; five is the prevailing number, but they differ from four to fifteen. The stamina are from five to three hundred, distinct, and attached, generally in rows to the receptacle. The seed-buds are usually numerous, and so also are the seeds. Most of these plants are acrid, many of them are poisonous. The leaves of all the species of clematis being bruised, and applied to the skin, burn it into carbuncles; and if applied to the nostrils in a sultry day, immediately after being plucked, will cause the same uneasy sensation as a flame applied to that part would occasion.

MULTIVALVES, in natural history, the name of a general class of shell-fish distinguished from the Univalves, which consist of only one shell, and the Bivalves, which consist of two, by their consisting of three or more shells. See CONCHOLOGY.

MUM, a kind of malt-liquor, much drank in Germany; and chiefly brought from Brunswick, which is the place of most note for making it.

MUMMY, a body embalmed or dried, in the manner used by the ancient Egyptians: or the composition with which it is embalmed. There are two kinds of bodies denominated mummies: the first are only carcases dried by the heat of the sun, and by that means kept from putrefaction: These are frequently found in the sands of Lybia. Some imagine, that these are the bodies of deceased people buried there on purpose to keep them intire without embalming; others think they are the carcases of travellers, who have been overwhelmed by the clouds of sand raised by the hurricanes frequent in those desarts. The second kind of mummies are bodies taken out of the catacombs, near Cairo, in which the Egyptians deposited their dead after embalming. For a further account of mummies, and the manner of embalming dead bodies, see EMBALMING.

We have two different substances preserved for medicinal use under the name of mummy, though both in some degree of the same origin: the one is the dryed and preserved flesh of human bodies, embalmed with myrrh and spices; the other is the liquor running from such mummies, when newly prepared, or when affected by great heat or damps. This latter is sometimes in a liquid, sometimes of a solid form, as it is preserved in vials well stopped, or suffered to dry and harden in the air. The first kind of mummy is brought to us in large pieces, of a lax and friable texture, light and spongy, of a blackish brown colour, and often damp and clammy on the surface: it is of a strong but disagreeable smell. The second kind of mummy in its liquid state, is a thick opaque and viscous fluid, of a blackish colour, but not disagreeable smell. In its indurated state, it is a dry solid substance, of a fine shining black colour, and close texture, easily broken, and of a good smell; very inflammable, and yielding a scent of myrrh, and aromatic ingredients while burning. This, if we cannot be content without medicines from our own bodies, ought to be the mummy used in the shops; but it is very scarce and dear, while the other is so cheap, that it will always be most in use.

All these kinds of mummy are brought from Egypt, but we are not to imagine, that any body breaks up the real Egyptian mummies, to sell them in pieces to the druggists, as they may make a much better market of them in Europe whole, when they can contrive to get them. What our druggists are supplied with, is the flesh of executed criminals, or of any other bodies the Jews can get, who fill them with the common bitumen, so plentiful in that part

of the world; and adding a little aloes, and two or three other cheap ingredients, send them to be baked in an oven, till the juices are exhaled, and the embalming matter has penetrated so thoroughly that the flesh will keep, and bear transporting into Europe. Mummy has been esteemed resolvent and balsamic; but whatever virtues have been attributed to it, seem to be such as depend more upon the ingredients used in preparing the flesh, than in the flesh itself; and it would surely be better to give those ingredients without so shocking an addition.

Besides the mummy, the human body has been made to furnish many other substances for medicinal purposes. Thus, the skull has been celebrated for its imaginary virtues against the diseases of the head: the very moss growing on the skulls of human skeletons, has been supposed to possess anti-epileptic virtues: the fat of the human body has been recommended as good in rheumatisms; and the blood, and, in short, every other part or humour of the body have, at one time or other, been in repute for the cure of some disease; but at present we are grown wise enough to know, that the virtues ascribed to the parts of the human body are either imaginary, or such as may be found in other animal substances. The mummy and skull alone, of all these horrid medicines, retain their places in the shops; and it were to be wished that they too were rejected.

MUNCHHAUSIA, in botany, so named from Baron Gerlach Adolphus de Munchhausen, a genus of the Polyadelphia Polyandria class and order. Natural order of Calycanthemæ. Salicariæ, Jussieu. Essential character: calyx six-cleft, torulose; petals clawed; stamens in six bodies, four or five in each; pistil superior, with a filiform curved style. There is but one species, viz. M. speciosa, a native of Java and China.

MUNICIPAL, in the Roman civil law, an epithet which signifies invested with the rights and privileges of Roman citizens. Thus the municipal cities were those whose inhabitants were capable of enjoying civil offices in the city of Rome: these cities, however, according to Mariana, had fewer privileges than the colonies: they had no suffrages or votes at Rome: but were left to be governed by their own laws and magistrates. Some few municipal cities, however, obtained the liberty of votes. Municipal, among us, is applied to the laws that obtain in any particular city or province. And those are called municipal officers who are elected to defend the interest of cities, to maintain their rights and privileges, and to preserve order and harmony among the citizens. Such as mayors, sheriffs, consuls, &c.

MUNTINGIA, in botany, so called from Abraham Munting, professor of botany at Groeningen, a genus of the Polyandria Monogynia class and order. Natural order of Columniferæ. Tiliaceæ, Jussieu. Essential character: calyx five-parted; corolla five-petalled; berry five-celled; seeds many, nestling. There is but one species; viz. M. calabura, villose Muntingia, a native of Jamaica on the calcareous subalpine hills; and of St. Domingo, in the moist parts of woods.

MURÆNA, the *eel*, in natural history, a genus of fishes of the order Apodes. Generic character: head smooth; nostrils tubular; gill-membrane ten-rayed; eyes covered by the common skin; body round, smooth; and mucous spiracle behind the head or pectoral fins. There are five species according to Shaw. Gmelin enumerates nine, of which the following are most deserving of notice. M. anguilla, or the common eel. This species is particularly distinguished by the steadiness or uniformity of its colours; an olive brown on the back, and silvery lustre on the sides and beneath; but more expressively still by the great elongation of its under jaw. Its general size is from two to three feet; it is slow in its growth, and considered as very long lived. Its usual food consists of insects, worms, and the eggs of other fishes. It is viviparous, producing great numbers at a birth; but of a very diminutive size. It continues generally during the day in its hole in the banks, which it furnishes with two avenues to facilitate its escape and security. By night it ranges for food. In winter it appears to be ingulphed in mud, and remains in this state of seclusion and tranquillity, if not torpor, till the return of spring invites it to a renewal of its excursions. In some places the fishery of eels is carried to very great extent, and in one of the rivers of France 60,000 are said to have been taken by the net in the course of a single day. They are wholesome food when taken in moderation. They are to be met with in almost all the rivers, lakes, and stagnant waters of the old world, abounding also frequently in its marshes. Their tenaciousness of vitality is so great, that they may be

preserved in a cool situation, without water, for hours and even days. It is stated by Linnæus, to quit the water frequently by night, and range the meadows in search of snails and worms; and, according to some writers, has been known to shelter itself in very severe weather in a hay rick; these circumstances, however, though not more extraordinary than many which are ascertained in natural history, appear to require further evidence. M. conger, or the conger eel, is generally darker above and more splendid beneath than the former species. It grows to its largest size in the Mediterranean, where it is sometimes found ten feet long, and of the weight of a hundred pounds. It is found in the North and American seas also: it occasionally, particularly in the spring, makes excursions into rivers, and is found in vast abundance in the Severn, constituting a cheap and luxurious food to the inhabitants in its vicinity. Congers are extremely voracious, devouring immense quantities of the smaller fishes, and of crabs before the shell of the latter is completely formed and hardened. They are in some places no trifling article of commerce, and in Cornwall, particularly, are taken with lines, having sixty or seventy hooks attached to each, baited with their favourite food. These lines are drawn to the land in the morning, having been sunk the preceding night, and generally exhibit a great number of victims. They are killed as fast as they are drawn to land, and if they wind about the legs of the man employed their compressive power is highly dangerous. They are then salted and dried, during which latter process two-thirds, or more, of the weight of the fish will not unfrequently drain off in oil. They are exported in large quantities to the coasts of Spain and Portugal. For the Muræna catenatus, chain-striped Muræna, see Pisces, Plate V. fig. 5.

MUREX, in natural history, a genus of insects of the Vermes Testacea class and order. Animal a Limax: shell univalve, spiral, rough, with membranaceous sutures; aperture oval, ending in an entire straight or slightly ascending canal. There are between two and three hundred species, separated into sections. A. Spinous, with a produced beak. B. Sutures expanding into crisped foliations; beak abbreviated. C. With thick protuberant rounded sutures. D. More or less spinous, and without manifest beak. E. With a long, straight, subulate closed beak, and unarmed with spines. F. Tapering; subulate, with a very short beak. M. Despectus, is about five inches in length: inhabits the deep sea. Dredged up in plenty with oysters. Eaten by the poor; but more frequently used as a bait for other fish.

MURIATES, in chemistry, a genus of salts formed from the muriatic acid with certain bases. When heated they melt, and are volatilized, without undergoing decomposition: they are soluble in water; effervesce with sulphuric acid, and white acrid fumes of muriatic acid are disengaged; when mixed with nitric acid they exhale the odour of oxymuriatic acid. There are twelve alkaline and earthy muriates. Muriate of potash, formerly called febrifuge, or digestive salt of sylvius, may be obtained by dissolving potash in muriatic acid, and evaporating the solution till the salt crystallizes: it has a disagreeable taste, and will dissolve in about three parts of cold water. Specific gravity 1.8. The constituent parts are nearly as follow:

Muriatic acid	29
Potash	63
Water	8
	100

Muriate of soda, or common salt, has been known from the earliest ages. It exists abundantly in nature. Immense quantities of it are found in different countries, which require only to be dug out and reduced to powder. In this state it is called rock salt. It is also one of the constituents of sea-water, which, when evaporated yields the salt in crystals. This salt usually crystallizes in cubes: its specific gravity is about 2.12, and it is soluble in less than three times its weight of water. When pure it is not effected by exposure to the air; but the salt of commerce contains some muriate of magnesia which renders it deliquescent. When heated, it decrepitates, and in a red heat it melts and evaporates in a white smoke without decomposition. It is composed of

Muriatic acid	44
Soda	50
Water	6
	100

See SALT.

Muriate of ammonia, formerly denominated sal-ammoniac, because it was found in great quantities near the temple of Jupiter Ammon, in Africa. It was till lately imported entirely from Egypt, but it is now made both in this country and on the

continent. In its common form it is an opaque mass, and is not affected by the air, but its crystals are liable to deliquesce. It is decomposed by the sulphuric and nitric acids, which combine with alkali; and likewise by potash, soda, barytes, and lime, which unite with the acid. By the latter of these decompositions ammonia is obtained in a state of purity: hence, by breaking into small pieces muriate of ammonia, with soda, or potash, &c. and putting them together in a phial with a glass stopple, we get a good smelling-bottle. This salt is used in many of the arts. In soldering, it cleans the surface of the metals to be united, and prevents their oxydation: in dying it renders several colours brighter, and it is not unfrequently employed in pharmacy and chemistry: it consists of

Muriatic acid	48
Ammonia	14.9
Water	37.1
	100

MURIATIC *acid*, in chemistry, may be procured in various ways: if a retort with a curved tube be half filled with well dried common salt, and some strong sulphuric acid be poured upon it, a copious effervescence takes place, and the elastic fluid extricated appears in the form of a white vapour as soon as it comes in contact with the atmosphere. When all the common air has been driven out of the retort, the subsequent portions of gas may be collected in the usual manner in glass jars, filled with mercury, and inverted in a bath of the same fluid. This is muriatic acid gas: it is transparent, colourless, and possessed of the same mechanical properties as common air. It is almost twice as heavy as common air: 100 cubic inches of it weighs nearly 60 grains. Its smell is pungent, and its taste highly acid. It is instantaneously fatal to animal life, and is incapable of supporting combustion; but if a burning taper be plunged into it, the flame, just before it goes out, may be observed to assume a green colour. If a little water be let into a jar filled with this gas, the whole gas disappears, and the liquid, which consists of a solution of muriatic gas in water, is usually denominated simply muriatic acid. Being obtained from salt, it was originally called "spirit of salt," then "marine acid," and now it is almost universally denominated "muriatic acid." A cubical inch of water, at the temperature of 60°, absorbs 515 inches of muriatic acid gas, which are equivalent to 308 grains: hence water thus impregnated contains more than half its weight of muriatic acid, in the same state of purity as when gaseous. During the absorption of the gas, the water becomes hot. Ice also absorbs this gas, and is at the same time liquified. The quantity of this gas absorbed by water diminishes as the heat of the water increases, and at a boiling heat water will not absorb any of it: of course the gas is easily expelled from the liquid acid by heat, and may readily be procured by heating the common muriatic acid of commerce. By this process Dr. Priestley first obtained it. The muriatic acid of the shops is always yellow, owing to a small quantity of iron which it holds in solution.

Muriatic acid is capable of combining with oxygen, and forms with it compounds, which have a considerable analogy to the compounds of azote with the same principle. When this acid is poured upon black oxide of manganese, a gas comes over, that is sometimes called "dephlogisticated muriatic acid," but more generally "oxy-muriatic acid." It is green, has a very bad odour, and is readily absorbed by water. The constituent parts of oxy-muriatic acid are

Muriatic acid	89
Oxygen	11
	100

When a current of oxy-muriatic acid is passed through water holding potash in solution, a number of flat shining crystals are deposited: these are denominated *hyper-oxy-muriate of potash*. They contain

Muriatic acid	34
Oxygen	66
	100

It does not appear that either hydrogen or carbon combines with muriatic acid, but charcoal absorbs it abundantly. Phosphorus absorbs a little, and sulphur imbibes it slowly. When mixed with nitric acid, it forms what was formerly denominated "aqua regia;" but is now called "nitro-muriatic acid." Muriatic acid in a state of gas neutralizes putrid miasmata, and destroys their bad effects. By this the most contagious diseases are prevented from spreading: two parts of sulphuric acid, and six of common salt, heated over a spirit lamp, or in a hot sand bath, will give out the gas very plentifully. The use of muria-

tic acid in the laboratory is very considerable; but in medicine and the arts it is employed only in the form of a muriate, or combined with some salifiable base. Nothing, says Mr. Aiken, takes off the crust of oxide of iron, which is sometimes found adhering to glass vessels, so safely and quickly as a little warm dilute muriatic acid.

MURRAYA, in botany, so named in honour of Joseph Andrew Murray, professor of medicine and botany at Gottingen, a genus of the Decandria Monogynia class and order. Natural order of Aurantia, Jussieu. Essential character: calyx five-parted; corolla bell-shaped, with a nectary encircling the germ; berry one-seeded. There is but one species; viz. M. exotica, ash-leaved Murraya, a native of the East Indies.

MUS, the *rat*, in natural history, a genus of Mammalia of the order Glires. Generic character: fore-teeth, upper, wedge-formed; three grinders almost always each side each jaw; clavicles in the skeletons. There are forty-six species, of which we shall notice the following:

M. zibethicus, or the musk rat, is as large as a small rabbet, and very common in Canada; and resembles the beaver in the shape of its body, and in its instincts and character. It lives in society, and constructs its habitation with great skill and art, about two feet in diameter, and stuccoed within with particular neatness, on the border of some lake or stream. On the outside it is covered with a matting of rushes, compacted with great closeness, to preclude moisture. These animals live on roots and herbage, which, however, they do not store up in their houses, but make excursions for as they are demanded during the winter; in summer they make long progresses in pairs. They have attached to them a strong odour of musk; and walk and run with great awkwardness; are easily tamed, and highly valued for their fur.

M. decumanus, or the Norway rat, is imagined to have been imported into Europe from India, and in this country has almost extirpated the animals known by the name of black rats, which formerly universally abounded in it. It subsists not only on grain and fruits, but frequently attacks poultry and rabbits, as well as various other animals. It is about nine inches long in the body, and nine more in the tail; will swim with considerable ease; is in the highest degree prolific, producing occasionally even eighteen young at a time, and breeding not unfrequently three times a year. It is bold, fierce, and voracious. When closely followed, it turns on its enemy, and fastens on him with its sharp and irregular teeth, inflicting a wound which it requires considerable time to heal. The depredations committed by these animals are calculated at an almost incredible amount. Their extreme fecundity, and their means of eluding the hostility of man in a thousand instances, render them one of the most serious nuisances. They plunder pigeon-houses, granaries, warehouses, and every species of stores convertible to food, with incessant rapacity and perseverance. They carry off sometimes considerable quantities of grain, and store it in their holes. They wage, however, most dreadful war on one another, and the weak become uniformly the victims of the strong. The large male rat, which generally lives in a mischievous and malignant solitude, is the most fatal enemy to his species. Dogs, cats, and weasels combine their efforts with those of man to produce their extirpation; but nothing appears capable of counteracting their rapid multiplication, and producing security from one of the most predatory and annoying animals which infests the society of mankind. Their sagacity is very extraordinary; and snares laid for them, after one victim has been known to fall by them, are generally laid in vain. The surest method of destroying them is by mixing poison with some favourite food, and laying it in their way. See Mammalia, Plate IX. fig. 4.

M. rattus, or the black rat, is considerably smaller than the former, and in this country has been nearly annihilated by it. Its habits are almost precisely similar to those of the former. It is supposed to come from the same countries; but is thought to be a native of North America also. It is reported by travellers, that in various parts of Germany it is sometimes taken and domesticated, and, having a bell put round its neck, is thus almost invariably found to alarm all others of its species from the vicinity.

M. amphibius, or the water rat, inhabits both the temperate and cold climates of Europe and Asia, frequenting the banks of rivers, in which it burrows. It subsists on frogs, and roots and other vegetable substances; swims with great speed, and can remain under water a considerable time. It is more thick and short in its body than several other species. It is never known to infest houses.

M. lemmus, or the leming. These animals are sometimes five inches long in the body, and in some countries (as Siberia) only three. They abound in the mountainous districts of Norway and Lapland. In their general habits they are by no means particularly social; but reside in a dispersed manner, without skilfully contrived habitations, or storing up in magazines. On certain occasions, however, they descend from their elevated situations into the plains, in innumerable and formidable multitudes. Their direction is always in a straight line, from which nothing induces them to deviate but the absolute impossibility of proceeding in it. Their track is visible by the destruction of herbage which attends it, the grass being devoured to its extreme roots, and their course exhibiting, instead of the greenness of vegetation, the brownness of a fallow. These migrations happen at irregular periods, generally after an interval of some years, and the perseverance and intrepidity with which they are conducted are matter of astonishment. If attacked by men, they will spring at the legs of the assailants, and with great difficulty can be made to quit their hold. Thousands are destroyed in these progresses by birds of prey, and often the most formidable and fatal conflicts occur among themselves.

M. œconomus, or the œconomic rat, resembles the leming in the circumstance of irregular migrations. These are met with, particularly in Siberia, burrowing with the greatest skill, and forming considerable magazines of provisions (chiefly various plants) for their winter consumption, and which they occasionally produce, if damp, to dry them perfectly in the sun. They are about five inches and a quarter in their whole length. In their migrations they swim over rapid rivers, preserving a course directly to the west, and experiencing extreme fatigue and peril, to which immense numbers of them become victims. A single party has been seen so numerous, as to take two hours in passing before the astonished spectator. Scarcity of food is supposed the grand impulse to these progresses. The inhabitants of Kamtschatka are said to rob the hoards of these animals in winter, pretending to make compensation by leaving some childish toy behind.

M. cricetus, or the hamster, is a species of the pouched rats, and the sole European species of that description. The pouches are one on each side of the mouth, and, when filled, are like two blown bladders. These animals are found in Poland and Russia, and are extremely injurious, by the quantities of grain which they devour, and also carry off for their autumnal store in their curious pouches. They are highly curious in the structure of their habitations. The females arrange their mansions differently from the males, and are stated never to reside with them. As winter approaches they seclude themselves completely, and enjoy their stores, which are generally consumed when winter reigns in full rigour, about which time they roll themselves up, and continue till spring in a state of profound slumber, or torpor. Their bodies are then said to be perfectly cold, and their limbs stiffened, and they may be opened without awaking them. The heart is seen to beat in them fifteen times in a minute, while in the summer its pulsations are 150 in the same time. The fat is said to be coagulated, and the intestines exhibit no excitability by the most stimulating applications. The waking of the hamsters from their lengthened sleep is a very gradual process, occupying sometimes no less than two hours. These animals are unsocial, fierce, and malignant. They attack every weaker creature, and very frequently destroy each other.

M. musculus, or the common mouse, inhabits almost every part of the world, is shy and timid, but not ferocious in its temper. It produces generally from six to ten at a birth, and breeds several times in the course of a year. Its skin is sleek, and its eyes are bright and lively; its limbs are neatly formed, and its movements are extremely agile. It is occasionally seen of perfect whiteness, and its appearance then is beautiful and interesting. It haunts the habitations of man, from which it is scarcely ever found at any considerable distance, and in which it commits no trifling depredations.

M. sylvaticus, or the long-tailed field mouse, is somewhat larger than the former, and of a yellowish-brown colour. It feeds on acorns, fruits, and grain, and lays up magazines in its burrowed mansion for the winter. It is found principally in dry grounds; is common in all the temperate regions of Europe, and is particularly abundant and destructive in France, where it is stated to commit more waste and havock than are effected by all other quadrupeds, and birds also. Under a scarcity of the usual supplies, these animals are supposed to destroy each other. Their stores in fruitful years are astonish-

ingly great, and nearly a bushel of nuts and mast is said to have been discovered in a single hole.

M. messorious, or the harvest mouse, is considered as the smallest of British quadrupeds, weighing only the sixth part of an ounce. Its nest is most artificially constructed and platted of the blades of wheat, and is of the size of a cricket ball, the opening to it being closed up so skilfully, as to be almost imperceptible. Such is its compactness, that it may be rolled over the table without derangement. One found of this description contained eight young, and appeared completely full without the dam, whose mode of access to it, so close and compact as it appeared on every side, seemed not easy to be explained. In the winter these animals burrow deep in the earth; but their favourite habitation is the corn stack.

For M. lineatus, or the lineated mouse, see Mammalia, Plate XVI. fig. 1.

For M. striatus, or the striated mouse, see Mammalia, Plate XVI. fig. 2.

MUSA, in botany, so named in memory of Antonius Musa, the freedman of Augustus, a genus of the Polygamia Monoecia class and order. Natural order of Scitamineæ. Musæ, Jussieu. Essential character: calyx spathe partial, many-flowered; corolla two petalled; one petal erect, five-toothed, the other nectariferous, concave, shorter; stamens six; style one; all the flowers hermaphrodites: male, hermaphrodite above; five filaments perfect; germ inferior, abortive: female hermaphrodite, one filament only perfect; berry oblong, three-sided, inferior, many-seeded. There are three species, of which M. paradisiaca, plantain tree, rises with a soft herbaceous stalk, fifteen or twenty feet in height: the lower part of the stalk is frequently as large as a man's thigh, diminishing gradually to the top, where the leaves come out on every side, which are often more than six feet long, and two broad: they are thin and tender, so that where they are exposed to the open air they are generally torn by the wind: when the plant is grown to its full height, the spike of flowers will appear from the centre of the leaves nearly four feet in length, nodding on one side; the upper part of the spike is made up of male or barren flowers; the fruit is about nine inches long, and more than an inch in diameter, a little incurved, having three angles; the skin is tough, within is a soft pulp of a luscious sweet flavour; the spikes of fruit are often so large as to weigh upwards of forty pounds. It is a native of the East Indies, and other parts of the Asiatic continent; it is generally cultivated between the tropics, and is universal in all the islands, that are inhabited, of the Southern Pacific Ocean. M. sapientum, banana tree, differs from the preceding in having its stalks marked with dark purple stripes and spots; the fruit is shorter and rounder, with a softer pulp of a more luscious taste; it has been noted for its efficacy in correcting those sharp humours, which generate or accompany the fluxes to which Europeans are frequently subject on their first coming into the West Indies. These two fruits are said to be among the greatest blessings bestowed by Providence upon the inhabitants of hot climates; three dozen plantains are sufficient to serve one man for a week instead of bread, and will support him much better.

MUSCA, in natural history, the *fly*, a genus of insects of the order Diptera: mouth with a soft exserted fleshy proboscis, and two equal lips; sucker furnished with bristles; feelers two, very short; antennæ generally short. This is a very numerous genus, not fewer than a thousand species have been enumerated. They are divided into sections; viz. A. with short feelers; and B. without feelers. These sections are again separated into others. The larva in the different tribes of flies differs far more in habit than the complete insects, some being terrestrial, and others aquatic. Those of the common kinds are emphatically distinguished by the title of maggots, and spring from eggs deposited on various putrid substances. Several of the aquatic kinds are of singularly curious formation, and exhibit wonderful examples of the provision ordained by nature for the preservation of even the meanest of animals. The general form of the pupa is that of an oval, differently modified, according to the species, and formed by the external skin of the larva. Some species cast their skin before their change into the pupa state. One of the most remarkable species is M. chamæleon, which is a large black fly, with a broad, flattish abdomen, having the sides of each segment yellow, forming so many abrupt semi-bands across that part. It proceeds from an aquatic larva, of very considerable size, measuring two inches and a half in length, which is common in stagnant waters during the summer months, and passes into its chrysalis state without casting its skin, which dries

[illegible]

... one. [illegible]

MUSCI, in botany, mosses, one of the seven families into which Linnæus divided all vegetables. The characteristics of these plants are, anthers without filaments: the male flower distinguished by the presence of the anthers, placed apart from the female, either on the same or distinct roots: the female flower deprived of the pistillum: the seeds destitute of both lobes, and proper coverings. These plants constitute the second order of the class Cryptogamia, which contains all the plants, in which the parts of the flower and fruit are wanting, or are not conspicuous. This order is subdivided into eleven genera, from the presence or absence of the calyx, which in these plants is a veil that is placed over the tops of the stamina, and denominated calyptra; from the sexes of the plants, which bear male and female flowers, sometimes on the same, sometimes on distinct roots, and from the manner of growth of the female flowers, which are sometimes produced singly, sometimes in bunches or cones.

MUSCI, is also the name of the fifty-sixth order in Linnæus's Fragments of a Natural Method, consisting of genera, which are exactly those of the second order in the class Cryptogamia. These plants resemble the pines and firs, and other evergreens in their stem, in the form and disposition of their leaves, and manner and growth of the female flowers, which are generally formed into a cone. They frequently creep and extend themselves like a carpet upon the ground, trees, and stones, collected into [illegible] or tufts. Few of the mosses are [illegible] plants; they are mostly perennial [illegible] evergreens. Their growth is remarkably [illegible]; though preserved dry several [illegible] these plants have the singular property of resuming their original verdure [illegible] being moistened. They delight in a [illegible] situation, and northerly exposure, where they are screened from the [illegible]. The roots are fibrous, slender, branched, [illegible] short. The stems and branches are [illegible], and weak, they creep on the [illegible], and strike root on every side.

MUSCICAPA, the fly-catcher, in natural [illegible], a genus of birds of the order Passeres. Generic character: bill flatted at [illegible], nearly triangular, notched each [illegible], at the nost beset with bristles; toes, in general, divided to their origin. These birds are of eminent utility in warm climates, by preying upon the numerous insects which swarm in them, and which would otherwise multiply to an extent, occasioning the most serious and intolerable annoyance. Latham enumerates seventy-eight species. Gmelin ninety-seven, of which it will be sufficient to notice the following:

M. grisola, or the spotted fly-catcher, arrives in this country in the spring, and leaves it in September. It attaches its nest not unfrequently to the end of a beam of a house, and sometimes builds it in a vine or sweet briar tree, spread against a wall, and appears to feel no inconvenience or alarm from the circumstance of many persons passing to the door, almost immediately under it, at every hour in the day. It returns for a succession of seasons to the same situation. It feeds on insects, which it catches with astonishing dexterity, sometimes on the wing, sometimes by a sudden leap from its perch, always returning to

its station with the object of its aim. It is one of the most silent and most familiar of summer birds. Its only note is a plaintive sound on the approach of danger. In Kent it is called the cherry-sucker, being particularly fond of that fruit.

M. atricapella, or the pied fly-catcher, is not to be found in great numbers in any part of this island, but is most frequently to be met with in Yorkshire, and the contiguous counties. A nest belonging to two birds of this species was taken in 1803, in Axwell Park, with a great number of young, and also the parent birds. The assiduity of the latter which were almost unremittedly employed in taking flies for their numerous family, was highly interesting. The dexterity and attention of the male bird appeared most conspicuous. See Aves, Plate X, fig. 3.

MUSCLE, in anatomy, a part of the human body, destined to move some other part, and that in general by a voluntary motion, or such as is dictated by the will; being composed principally of flesh and tendinous fibres, which have also vessels of all kinds, as arteries, veins, nerves, and lymphatics; all which are surrounded by, or enclosed in, one common membrane. See Anatomy.

In a chemical view, the muscular parts of animals are known in common language by the name of flesh. They constitute a considerable proportion of the food of man. Muscular flesh is composed of a great number of fibres and threads, of reddish or whitish colour; these, after they have been acted on by water, in order to separate the extraneous matter from them, are left in the state of grey fibres, insoluble in water, and becoming brittle when dry. The substance possesses all the properties of Fibrin, which see. Besides fibrin, they are found to contain albumen, gelatine, extractive, phosphate of soda, of ammonia, and lime.

The muscles of different animals differ exceedingly from each other in their appearance and properties, at least as articles of food; but we know little of their chemical differences. The observations of Thouvenel alone were directed to that object, and they are imperfect. The flesh of the ox contains, according to him, the greatest quantity of insoluble matter, and leaves the greatest residuum when dried; the flesh of the calf is more aqueous and mucous; the land and water turtle yields more matter to water than the muscle of the ox; but Thouvenel ascribes the difference to foreign bodies, as ligaments, &c. mixed with the muscle of the turtle. Snails yield to water a quantity of matter intermediate between that given by beef and veal: with them the muscles of frogs, cray fish, and vipers, agree nearly in this respect; but the muscles of fresh water fish, notwithstanding their softness, yield a considerably smaller proportion. When meat is boiled, it is obvious that the gelatine, the extractive, and a portion of the salts will be separated, while the coagulated albumen and fibrin will remain in a solid state. Hence the flavour and the nourishing nature of soups derived from the extractive and gelatine. When meat is roasted, on the other hand, all these substances continue in it, and the taste and odour of the extractive is greatly heightened by the action of the fire. Hence the superior flavour of roasted meat. Fourcroy supposes, that the brown crust which forms on roasted meat is composed entirely of the extractive. The cutis is a thick dense membrane, composed of fibres interwoven like the texture of a hat. When it is macerated for some hours in water, and agitation and pressure are employed to accelerate the effect, the blood, and all the extraneous matter with which it was loaded, are separated from it, but its texture remains unaltered. On evaporating the water employed, a small quantity of gelatine may be obtained. No subsequent maceration in cold water has any further effect. When distilled, it yields the same products as fibrin. The concentrated alkalies dissolve it, converting it into oil and ammonia. Weak acids soften it, render it transparent, and at last dissolve it. Nitric acid converts it into oxalic acid and fat, while, at the same time, azotic gas and prussic acid are emitted. When heated it contracts, and then swells, exhales a fetid odour, and leaves a dense charcoal, difficult to incinerate. By spontaneous decomposition in water or moist earth, it is converted into a fatty matter, and into ammonia, which compose a kind of soap. When allowed to remain long in water, it softens and petrifies, being converted into a sort of jelly. When long boiled in water it becomes gelatinous, and dissolves completely, constituting a viscid liquor, which, by proper evaporation, is converted into glue. Hence the cutis of animals is commonly employed in the manufacture of glue. From these facts the cutis appears to be a peculiar modification of gelatine,

enabled to resist the action of water, partly by the compactness of its texture, and partly by the viscidity of the gelatine of which it is formed; for those skins which dissolve most readily in boiling water afford the worst glue. The skin of the eel is very flexible, and affords very readily a great proportion of gelatine. The skin of the shark also readily yields abundance of gelatine; and the same remark applies to the skins of the hare, rabbit, calf, and ox; the difficulty of obtaining the glue, and its goodness, always increasing with the toughness of the hide. The hide of the rhinoceros, which is exceedingly strong and tough, far surpasses the rest in the difficulty of solution and in the goodness of its glue. When skins are boiled, they gradually swell, and assume the appearance of horn; then they dissolve slowly.

MUSEUM, a collection of rare and interesting objects, selected from the whole circle of natural history and the arts, and deposited in apartments or buildings, either by the commendable generosity of rich individuals, general governments, or monarchs, for the inspection of the learned and the great mass of the public.

The term which means, literally, a study, or place of retirement, is said to have been applied originally to that part of the Royal Palace at Alexandria appropriated for the use of learned men, and the reception of the literary works then extant. According to ancient writers, they were formed into classes or colleges, each of which had a competent sum assigned for their support; and we are further informed, that the establishment was founded by Ptolemy Philadelphus, who added a most extensive library.

It would answer little purpose to trace the history of museums, as the earlier part of it is involved in much obscurity, and as we approach our own time they multiply beyond a possibility of noticing even the most important. Within our brief limits we shall, therefore, confine ourselves to those at the Vatican, Florence, Paris, Oxford, and London. That of the Vatican might originally have been said to occupy every apartment of the palace, which are more numerous than in any other royal residence in the world: the pictures, the books, the manuscripts, statues, bas reliefs, and every other description of the labours of ancient artists, were select, uncommon, and valuable, in the extreme, particularly the Laocoon, which some authors assert is the same that adorned the palace of the Emperor Titus, and mentioned by Pliny, as *Opus omnibus et picturæ, et statuariæ, artis, præferendum*, who adds, that it was made by Agesander, Polydorus, and Athenodorus, natives of Rhodes, from a single mass of marble, which circumstance has since caused a doubt whether the groupe of the Vatican is really the original, as Michael Angelo discovered that it is composed of more than one piece. It was found in 1506, near the baths of Titus, and, whether an original or a copy, has obtained and deserves every possible admiration.

This invaluable collection continued to increase for several centuries, and till nearly the present period, when Rome narrowly escaped another sacking; but as a taste for the arts has fortunately distinguished the French, in some particular instances, it appeared in this, as a transfer of the richest articles to France has happily been preferred to destroying them.

The Grand Dukes of Tuscany were for a long series of years ardent admirers of the arts, ancient and modern, and regretted no expense in obtaining the most rare and beautiful objects which vast treasures were capable of procuring; consequently their museum at Florence vied with that at Rome, and, in some instances, the value of particular articles exceeded any possibility of rivalship; we allude to the Venus de Medicis, of which Keysler speaks thus, in his excellent account of part of the continent, "I shall conclude this short criticism on the celebrated Venus de Medicis with the following observation, made by some able connoisseurs, namely, that if the different parts of this famous statue be examined separately, as the head, nose, &c. and compared with the like parts of others, it would not be impossible to find similar parts equal, if not superior to those of the Venus de Medicis; but, if the delicacy of the shape, the attitude, and symmetry of the whole be considered as one assemblage of beauties, it cannot be paralleled in the whole world. This beautiful statue is placed between two others of the same goddess, both which would be admired by spectators in any other place; but here all their beauties are eclipsed by those of the Venus de Medicis, to which they can be considered only as foils to augment the lustre of that admired statue." The effects of the present dreadful, and apparently endless war, were severely felt at Florence; nor was it to be supposed that the museum of the Grand Duke

would escape unmolested, when the contents of others, far less important, were conveyed to Paris; aware of the probable fate of the best articles, many of them are said to have been removed to places of safety, and particularly the beautiful Venus, and the Hercules Farnese, to Sicily. Little is known in England of the state of the Florentine Museum, but it is feared to be deplorable.

We shall now turn our attention to the *Musée central des Arts*, formed in the Louvre at Paris, composed from the best collections on the Continent, and consequently consisting of the finest specimens of human art extant, which money could not procure, and supreme power alone could command from their previous situations, in the different circles of Germany, Holland, and the states of Italy. The only circumstance tending to alleviate the regret arising from this universal plunder, is the thought that every facility is afforded for viewing and studying the excellence of the various articles which can be expected or desired. The method adopted for arranging the paintings thus assembled is judicious, as they are classed in nations, by which means the eye is conducted gradually to the acme of the art in the works of the Italian masters.

The gallery of antiquities is directly below the gallery of pictures; and to give some idea of the nature of the general contents, we shall mention the names of the several divisions, which are: La Salle de Saisons, la Salle des Hommes illustres, la Salle des Romains, la Salle de Laocoon, la Salle de l'Apollon, and la Salle des Muses. The Laocoon, which we have noticed in our account of the Vatican, here receives distinguished honour within a space railed in; and the Apollo Belvidere is equally honoured in giving name to one of the halls. These exquisite works are described in a catalogue, which may be obtained in the gallery; and of the manner we shall venture to give a specimen, hoping that a similar method may be adopted to explain the objects offered to view in our national repository. Under the head Pythian Apollo, called the Apollo Belvidere, the author of the catalogue observes, "This statue, the most sublime of those preserved by time, was found near the close of the fifteenth century, twelve leagues from Rome, at Capo D'Anzo, on the borders of the sea, in the ruins of ancient Antium, a city equally celebrated for its Temple of Fortune, and for its pleasant mansions, erected by successive emperors, which, emulous of each other, they decorated with the most rare and excellent works of art. Julius II. when a cardinal, obtained this statue, and placed it in the palace were he resided, near the church of the Holy Apostles. After his elevation to the pontificate, he had it removed to the Belvidere of the Vatican, where it remained three centuries an object of universal admiration. A hero, conducted by victory, drew it from the Vatican, and causing it to be conveyed to the banks of the Seine, has fixed it there for ever."

Another museum established at Paris, since the return of order, is that of the National Monuments, those were indiscriminately destroyed, or mutilated, during the first frantic emotions of the late revolution; and this act contributed not a little to the general dislike it excited: at length the most enlightened part of the National Convention decreed imprisonment in chains to those who should thenceforward injure, or destroy, the marble and bronze records of their country. Le Noir, a man of taste and learning, seized this opportunity for rescuing the French nation from the reproach it had incurred by destroying what was honourable to themselves, and conceived that, though late, it might still be possible to collect whole monuments in some instances, and fragments in others, sufficient to interest foreigners in favour of his country, or at least to evince to them that a change in sentiment had occurred. Fortunately his plan received public encouragement, and he has, through the assistance of government, procured an astonishing number of specimens from all parts of the kingdom. Mr. Pinkerton observes of this collection, "It will not escape the attention of the reader of taste that the arrangement is confused, nay, often capricious, and is capable of great improvements." And Le Maistre says, upon the same subject, "After several hours employed in this second view, I continue of my former opinion, that the spot (formerly a convent) in which these monuments are collected, is infinitely too small; that the garden, meant to be the tranquil site of sepulchral honours, and the calm retreat of departed grandeur, is on so limited a scale, is so surrounded with adjoining houses, and altogether so ill arranged, that instead of presenting the model of

"Those deep solitudes ....
Where heav'nly pensive contemplation dwells,
And ever musing melancholy reigns,"

it might easily be mistaken for the working yard of a statuary, or the pleasure ground of a tasteless citizen, decked out with Cupids, Mercuries, and Fawns." Both these authors, however, agree in praising the motives and perseverance of Le Noir.

Oxford has the honour of having produced the first, and not the least important museum in England, which was founded in 1679, and the building completed in 1683, at the expense of the university; the students, the public, and the professors of which, are indebted to Elias Ashmole, Esq. for an invaluable collection of interesting objects presented by him for their use, and immediately placed within it; since which period it has been called the Ashmolean Museum. The structure, of the Corinthian order of architecture, has a magnificent portal; and the variety and value of the articles contained in it renders a visit to the apartments highly gratifying, particularly as they are increased from time to time, and as often as rare objects can be procured.

The British Museum, a repository under the immediate care of government, and itself governed by fifteen trustees, selected from the highest and most honourable offices of the state, promises to exceed every other national institution which is not supported by the casual and unworthy plunder of others. However inferior it may appear to those splendid collections which consist of the most exquisite productions of the chissel and the pencil ever accomplished by man, we have the consolation to reflect that had it been possible to procure them by purchase, the liberality of the British nation is such, that Italy and many other countries would have long since been drained; but as the case is, each inhabitant of England may exclaim, as he views the vast collection he in common with all his countrymen possesses, and with his characteristic integrity, these are individually our own by fair purchase or gift. Sir Robert Cotton may be said to have laid the foundation of the British Museum, by his presenting his excellent collection of manuscripts to the public; those, and the offer of Sir Hans Sloane's books, MSS., and curious articles in antiquity and natural history, for 20,000*l.* suggested the propriety of accepting the latter, and providing a place for the reception of both; from this time government proceeded rapidly in forming the plan, and at length every interior regulation for officers, trustees, &c. being made, Montague House, situated in Russell-street, Bloomsbury, was purchased for 10,250*l.* and fitted for the reception of the articles then possessed, and to be bought, at the further expense of 11,184*l.* 6*s.* 4*d.*; after which Lord Oxford's manuscripts were procured for 10,000*l.* to which the King added others, and since the above period vast numbers of interesting things have been placed there, particularly Sir William Hamilton's discoveries, a vast variety of valuable medals, fossils, minerals, manuscripts, and printed books, together with several Egyptian antiquities, and the late Mr. Townley's marbles and bas reliefs from Italy. The latter were given to the public under the express condition that a proper place should be built for their reception, which has been complied with, and they are now exhibited with the rest of the museum to an admiring multitude, amounting daily to upwards of ninety persons. Various alterations have taken place in the regulations adopted for the convenience of those who read at the museum, and the visitors, since 1757, when it was first opened for inspection and study, and it is but justice to say, each was intended well, though till lately it was generally thought that too many impediments existed in the way of visiting that which was solely intended for the use of the community; at present, however, no such complaint can be made with truth, as any decently dressed persons, presenting themselves at certain hours, are conducted, free of every kind of expense, through the suite of rooms by civil and well-informed officers, who explain the uses and nature of each object. Admission to the reading room is, besides, attended with no other difficulty than necessarily follows ascertaining whether the applicant is deserving of the indulgence, or likely to injure the interests of the institution; when there, every facility is afforded him by commodious tables, with pens and ink for writing, and a messenger waits to bring him any books he may think proper to select from the vast stores of literature submitted in this generous way to his use.

MUSES, certain fabulous divinities amongst the Pagans, supposed to preside over the arts and sciences: for this reason it is usual for the poets, at the beginning of a poem, to invoke these goddesses to their aid. Some reckon the muses to be no more than three, *viz.* Mneme, Aoede, and Melete, that is, memory, singing, and meditation: but the most ancient authors, and particularly Homer and Hesiod, reckon nine, *viz.* Clio, which means glory; Euterpe, pleasing;

Thalia, flourishing; Melpomene, attracting; Terpsichore, rejoicing the heart; Erato, the amiable; Polyhymnia, a multitude of songs; Urania, the heavenly; and Calliope, sweetness of voice. To Clio, they attributed the invention of history; to Melpomene, tragedy; to Thalia, comedy; to Euterpe, the use of the flute; to Terpsichore, the harp; and to Erato, the lyre and lute; to Calliope, heroic verse; to Urania, astrology; and to Polyhymnia, rhetoric.

MUSHROOM. See AGARIC.

MUSIC. Any succession of sounds, however much they may vary in regard to duration, or however much they may partake of various modes or keys, provided that succession be agreeable, and excites, in a well tuned ear, certain agreeable sensations, is called music. Hence, it is obvious that all persons are not competent judges; for we often find individuals who have not only a natural defect in what we call the taste for music, but who cannot even sing three notes together without offending the ears of those who are happily blessed with that perfect formation of their organs which disposes to the duly receiving, and of correctly expressing, the most undeviating pureness of melody.

Although we certainly may meliorate our taste, and indeed improve the ear, by constantly attending to correct sounds, and by making a rule never to allow the smallest trespass on the part of our voices, &c.; yet it may be generally said that the passion, and the capability for music, must be innate. We could quote many instances of mere infants, even before they could speak, being perfectly competent to judge of what is commonly called "Music in or out of tune." All animals, however furious, appear delighted with music, which affects them differently, according to their several dispositions. Birds are even fascinated by the upper notes of a fine voice, and at all times we find such as have agreeable notes of their own, peculiarly attentive to every pleasing succession of sounds.

The most indispensable points in music are tune and time. The former relates to that perfect intonation of every sound which gives its proper degree of sharpness, or otherwise, proportioned to its situation, and to its relation to those sounds which precede, or which follow. The latter is the art, or rather the talent of bestowing the proper extent of each note's duration, according to the situation in which it is placed, and according to its relative value, as ascertained by that regular appreciation ascribed to it in the bar, according to established laws on which the time table is founded, as will be shewn in its proper place. It may be necessary, however, to state that one exception is made from this, otherwise immutable, rule: namely, in vocal music, where the singer indulges in the prolongation of a note at pleasure; but such is only to be tolerated when a shake, a cadence, &c. allow the digression, without trespassing on the execution of the accompaniments, or violating that chaste adherence to the character of the piece, which should ever regulate the singer. This, however, is a point from which many of our first performers, both vocal and instrumental, deviate in a most unwarrantable manner; often destroying the best effects of composition, by an indulgence in the most *outré* and inappropriate flourishes.

In speaking of tune we are necessarily to proceed by comparison; thus we call those shrill sounds which pierce the ear, acute or high; to this class appertain the natural tones of infantine voices, while the intonations of manhood vibrate with less shrillness upon the ear, and appertain to that class we term grave or low sounds. This will be more clearly understood when we state, that singers are divided into various classes, which accord with the supposed division of the voices of mankind into six different species, viz. the bass, which is the lowest of all; the basitono, or tenor-bass; the tenor and counter-tenor, which are the two middle species, of which the generality of mens' voices partake; the mezzo-soprano, which is the pitch of women's voices in general, and the soprano, *i. e.* the treble or uppermost, which in some women reaches to a great height, and in our cathedral service, &c. is usually allotted to young boys.

The voices of women, and of children, are, with very few exceptions (and those exceptions always appear unnatural, and are displeasing to the ear) a whole octave above the voices of men. The voices of girls do not suffer by puberty, at least not as to the acuteness of their sounds, though they often lose their clearness, and a portion of the extent upwards; but that arises from an injury done to the organs, often by overstraining while young, or by a want of practice, &c. whence the facility of inflexion, and of modulation, are essentially impaired. But with males the case is very different; for, so soon as they arrive at puberty a

rapid change takes place, whereby the whole compass of the voice is sunk an octave, or eight notes. Thus a boy who, at the age of ten or twelve, should be able to sing a piece of music in alt, that is, in high notes, when arrived at the age of sixteen or seventeen, in singing the same passages, would in reality be singing exactly an octave lower. The change is not regular as to any particular year; it varies greatly; some lose their voices even at twelve years old; these are, for the most part, of that class which never were above a counter-tenor, and sink into a basitono, or to a full bass. The few who are able to preserve their high pitch until seventeen, or perhaps eighteen years, rarely fall lower than the counter-tenor, and ordinarily become sopranos. These, however, are rare. In estimating voices we are not to judge from the high notes occasionally produced, and which are the effect of much study and practice. This stile is called the falsetto, and is an artificial voice, the junction of which to the natural intonation, so as to be perfectly smooth, is extremely difficult, and very rarely is found perfect, in even our best singers. Castration is supposed to produce this fictitious voice; but it is supposed that, not one victim in a thousand of that description is rewarded by its attainment. Nature, indeed, seems to be very whimsical in this particular; for some castrati receive not the smallest benefit; they having, after all, deep-toned voices. This, it is true, does not often occur: the generality acquire, or rather perpetuate, a kind of mezzo, or middle intonation, more offensive than gratifying to the hearer.

The degrees of strength, the loudness, or the softness of voices, have no effect whatever on the pitch or relative tone; for we may whisper in bass, and bawl in soprano. Therefore when we say high or low, we either put the intonation to some audible test, as by reference to the sounds of instruments, &c. whose exact pitch is previously ascertained; or, in our minds, we form an estimation by aid of the memory, which refers to the graveness or acuteness, as it may happen, of some instrument with whose notes the voice in question seems to correspond. Thus high and low are positive definitions, which force, or the accumulation of strength, as in choruses, will not render shriller or more acute, nor softness and whispering, render more deep or graver. The terms are, however, only to be considered as arbitrary; for they have no real foundation in regard to the nature of sounds, and seem to depend entirely on the manner in which music is written, the shriller tones being placed the highest on the stave of fine lines, and the deepest tones being represented by the lowest notes; thus forming a gradual decrease of acuteness from the highest to the lowest, which declension being, by this means, represented to the eye, enables us to judge, without hesitation, as to the pitch of the several intonations thus represented. By this means we are able to compare the pitch of two voices, or of any number of instruments whereby they might be accompanied; for by inspecting the music as written on the stave, and observing the relative ascendance of the notes, as allotted to, or as they could be executed by each singer, we at once decide that the person performing those notes which reach the highest on the stave, sings higher than the other; therefore if they should sing in parts, we should say the highest singer of the two took the first, and the lowest singer the second part of the music. The ancient Greeks used the terms high and low, in an opposite sense to what is above described. The lyres in use among them were so varied, that their gravest sounds were produced from the uppermost strings, and *vice versa*; hence they called the deepest notes high, and the acuter notes low.

It is not to be supposed that all the sounds which can, by any means be produced, should be represented on the five lines, called the stave, although we never see more lines ruled for that purpose, the whole length of the stave. There are many notes carried far above, and far below; their relative sounds are distinguished, by what are called ledger (properly legers, or light) lines, the number of which serve to show the degrees of altitude or of depression respectively. But it must be obvious how ineffectual even this substantial aid would be to specify all the intonations contained in the six species already noticed. It is true the upper, or soprano, species, admits of much explanation by the addition of perhaps four or five ledger lines above the stave; but the great number of sounds below the stave would require such a number of ledger lines under it, as would inevitably create confusion, and render it impossible for the most quick-sighted, and most practised performer to follow the melody with precision. To remedy this inconvenience, and to do away many other practices which

though improvements on the modes of the earlier ages, were not only very defective, but seemed to debar the progress of this pleasing science, the celebrated John de Murio, who lived in the fourteenth century, offered to the world a new system (from which very few alterations have since been made), whereby not only the value, *i. e.* the proper duration or holding of each note, was clearly defined by certain marks, but the compass, or extent of each voice, or part, was distinctly laid down by appropriate clefs, or keys, which are now vulgarly called cliffs. Until that time the pitch and value of every note were known only by letters and signs used for the occasion, according to Guido's notation.

This change was peculiarly important, and received additional approbation from its great simplicity; by it the whole orchestra were divided into three great classes, namely, the trebles, the tenors, and the basses; which, at the same time, the voice parts were more methodically arranged into five parts, consisting of two trebles (*i. e.* first and second), two tenors, and one bass, forming what we call a quintett; but in general only four were used, namely, the soprano, the counter-tenor, the tenor, and the bass; and, indeed, such seems, on the whole, to be the most natural division, for as we rarely find more than four notes used in any chord that is sounded at the same moment, so it appears proper that the number of parts, vocals at least, should be comprised within that arrangement; fewer would often cause the omission of many notes whereon the harmony might essentially depend. The propriety of this will be more evident when we come to treat of discords.

In speaking of parts we are not to conclude that music is now confined to any particular number, although four, or five at the furthest, are as many as can be generally found useful, or even applicable to the purposes of our most conspicuous exhibitions, such as operas, oratorios, &c. Various eminent composers have arranged their pieces for even as many as fifteen or sixteen voices, each independent, and not merely the repetition or echo of others; these are called real parts, in contradistinction to such as are similar to others, but being performed on different instruments, or being an octave higher or lower, become mere reinforcements. Thus when we see an orchestra of forty or fifty performers, we are not to conclude that each performs a succession of notes differen from his neighbours; on the contrary, all who play the first violin parts, play exactly the same passages throughout; the seconds have also their part of the composition, which they play together; the tenors, first and second, sometimes in the same manner; the basses are also of various descriptions, such as the violincellos and the double basses. The wind instruments, such as the horns, trumpets, trombones, flutes, oboes, clarinets, the bassoons, and the serpents, are also classed, though each in general has its separate part, which, when sustaining any full passage, blends freely with the others of its own class, rarely deviating much therefrom, except in solo passages, wherein peculiar effects are to be produced. It may be supposed that most of these parts must be duplicates of others, either throughout, or partially, when we consider that the performer at the organ or harpsichord plays all the harmony concentered, as it were, under his own hand. Knowing this, we must view the formation of numerous vocal parts, merely as an exercise in the arts of permutation; as we see the youths of various parishes emulating in the ringing of various peals on the bells; or we must judge, that in instrumental music the various parts are necessary to produce a superior effect, derived from the judicious appropriation of various passages, or of various emphatic and accented notes, to those instruments most suited to the desired expression. We shall not be at a loss to estimate this branch of the science duly, when we call to mind, that by such a contrivance, which is by no means superficial, some composers have so completely expressed the passions of love, hatred, fear, grief, joy, &c. as to cause their audiences to become deeply affected, according to the intention and character of the music.

The relative gravity and acuteness of sounds were, as we have said, first arranged into a systematic point of view by John de Murio. He abolished the obscure and indefinite punctuations, &c. of his predecessors, and contrived the grand musical scale now in use, and which, notwithstanding the wonderful advances made in the science since his time, but especially within the last century, remains exactly as he first ushered it into the world. This we may presume to be the surest proof both of its excellence, and of his genius, for Murio was original in his invention, which does not appear to be, in any shape, built upon the

devices of his seniors in the art. The following description, aided by reference to the plate will, we trust, convey to the reader the fullest idea of the inventor's merit, and, at the same moment, afford so complete an insight into the succession of sounds, and to the allotments of parts marked with different clefs, as must give the utmost satisfaction.

Fig. 1, Plate Music, exhibits the grand musical scale of John de Murio, consisting of eleven lines. The five uppermost are distinguished by a figure something like that which serves as an abbreviation for the word *and*—thus &. It was formerly meant for a written G, and is supposed to stand on the second line of the five included in the treble stave, *i. e.* the eighth of the whole stave, reckoning, as is the invariable rule in music, from the bottom upwards. This figure is called the G clef, and purports that the music standing on the stave appertains to the treble class of voices, or of instruments. The order, and the names of the notes appertaining thereto, are severally shewn, commencing with that G which stands under these ledger lines, and rising to D in alt, which will suffice to exemplify the extent of five octaves, and the manner in which the ledger lines are used to such notes as do not come within the compass of the stave.

The five lowest lines in the stave appertain to the bass clef, which is distinguished by an inverted C standing to the fourth line, on each side of which is a large dot, close to the back of the C. The presence of this sign denotes that the music appertains to that class of voices, or of instruments, whose deep tones rank them among the bass, or lowest species. The ledger lines appropriate to the basses, all stand below the first line of their stave, in contradistinction to the treble ledgers, which stand above. this is necessary to be well understood, because whenever ledgers are added above the bass stave, the music, in reality, has changed its subordinate station, and has ascended into the class of tenors and sopranos, as will be seen. Nor can ledgers be added under the treble stave, without causing the music to partake of those tones which are also appropriate to the tenors. For the treble clef G, and the bass clef F, cannot be changed from the lines on which they are placed, and to which they respectively give name: the second of the treble being called the G line, and the fourth of the bass being called the F line.

The sixth, or middle line, which, for the sake of distinction, is made much thicker than the other ten, is called the C, or tenor line. Its characteristic sign is made by three perpendicular lines, extending to a depth corresponding with the thickness of the whole stave, *i. e.* of five lines, and terminated by a K; the two middle perpendiculars are joined by two short, thick, horizontal lines, equidistant from their centres. This sign is called the C, or tenor clef; it is moveable, but on whatever line its centre stands, the notes upon that line all become C, and the whole nomenclature of the notes on the stave changes in conformity thereto. The tenor clef governs the stave it is on, and occasions those who sing or perform its music to be called tenors; but of different degrees, according as the stave is found. This requires particular description: the tenor clef may remain on the C line, and taking two lines from the bass, and two from the treble, complete its stave: in such case it is called the alto, and is always prefixed to every line of the music intended to be played on the tenor violin, or alto, or quinte, as it is variously designated. It also applies to such voices as answer to that particular pitch. But as the greatest variety of voices lie between the treble and the bass parts, it was found necessary to move the tenor clef higher or lower, for the purpose of accommodating to those many and various compasses which were found to be the greatest supports to the harmony; they connecting the extremes, *i. e.* of treble and bass, and sustaining the great body of the chorus, &c. To effect this, instead of confining the tenor stave to the C line, added to the two adjoining upper lines of the bass, and to the two lower of the treble, liberty was given to take, at pleasure, one, two, three, or even four lines from the treble, adding them above the C line: thus requiring only one, two, or three lines to be taken from the bass stave to complete the tenor stave to five lines. Hence we see, that instead of taking two lines from the bass, and two from the treble, as is done at A, fig. 1, to form the complement of its stave; at B it takes only one from the treble, and adds three from the bass to form a stave, which sinks the whole of the music a fifth, *i. e.* five notes. Again, at C, it borrows none from the bass, but takes four lines from the treble; this is called the soprano-tenor clef, which depresses the music one third, that is, three notes. it is usually applicable to such voices

as are rather above the common pitch of the tenor and counter tenor, and of course rank as seconds, in chorusses, glees, &c.

Composers frequently make use of the clefs, the tenor especially, for the purpose of transposing into other keys with the utmost facility: thus, if a piece of music be composed in the key of D, with two sharps, by annulling the sharps, and placing the tenor clef on that line where D stood, the whole piece is transposed one note lower. In the hurry of composition this is essentially useful, regarding such parts as are intended for horns, trumpets, &c. which never having sharps or flats prefixed to their staves, but being guided by a written notice as to what key the crooks should be arranged to (for their music is always written in C natural) by observing the clef, instead of any superscribed direction, and the proper crooks being affixed, according to the clef, the performers go through their parts without difficulty. The great importance of becoming perfectly familiar with this useful and versatile clef, must be obvious, indeed the deficiency of a competent and ready knowledge of it, at sight, is not merely a disadvantage, but in many instances a complete disqualification; especially to public performers, who are often served with parts, either separately copied, or in a score, which they are expected to go through without hesitation or error.

Etymologists differ in regard to the derivation of the terms treble, tenor, bass, used for the names of the clefs. Some derive treble from the theatre, others from the old practice of singing trios, in which the middle part, thence said to be called the tenor, bore the burthen, while the upper voice proceeded always a third, *i. e.* a treble above it. In all probability the latter is the most correct, though at the best we can only venture a conjecture, the strict derivation having been lost. The origin of the term tenor may, as some authors assert, be from the verb *teneo*, to hold; but the manner of its application, though from the same root, may be somewhat different; some have hinted, and not without reason, that it was on account of the tenor being that link which held the upper and lower parts together. As for the bass that evidently proceeds from *bas*, *i. e.* low.

Having premised thus much, regarding those points which we deemed of much importance, to have fully explained, before we proceed to detail the relations of notes, in regard to their places and to their distances on the stave, or scales, we will now treat of the latter, and also of the mode of ascertaining the key in which the music is composed. Respecting the value or duration of the notes, we shall reserve what is necessary to be stated, until we come to explain that most important matter, the time table.

There are but seven sounds in music, which are distinguished by the letters A, B, C, D, E, F, and G. The situation of the original sounds, of which all bearing those names are replicates, whether they be above or below those seven which we assume in any part of the stave as a standard, it is perhaps out of our power to ascertain, for every atom in nature is capable of producing some sound corresponding with some part of our scale, either perfectly in unison, or inclining to be sharper or flatter. Whatever may be the sound produced, we can, by the various means in common use, accommodate our instruments thereto. Thus, if any tone is heard, we can, to a certainty, accord without deviating more than four notes either above or below the then pitch of the instrument that it is to imitate. For supposing a string to be tuned to A, and that a sound corresponding with the note E below it, were heard, the intonation would be perfectly imitated, by relaxing the string until it should have descended six semi-tones, or a fourth; it would then correspond so very exactly, as to be in perfect unison with the sound in question; but if, instead of relaxing, the string were to be tightened, so as to cause its note to be raised eight semi-tones, or a fifth, the two sounds would blend completely, not in perfect unison, but in replicate unison; for the former term, in its strict sense, relates to sounds which positively yield the very same note in the same part of the scale.

This requires no proof to persons skilled in acoustics, or the science of sounds; but its demonstration would occupy more space than can be allotted to this article; under the head of SOUNDS more will be said. At present it suffices to state, that all notes of the same name are considered by harmonists as being the same note, as will be shewn; though the effects produced by placing them differently, in various parts of chords, are extremely various. The melodist who is utterly unacquainted with music as a science, and who whistles, or sings, either a well known air, or the wild effusions of his own imagination, naturally concludes, that every sound he can produce, from the

lowest to the highest pitch of his compass, is a distinct note; not considering, that a woman or a child, who should sing the same tune with him, in what is called unison, (*i. e.* in the same sound), would absolutely sing throughout, in a parallel of notes, one octave above him! or, that, if accompanied by a bass voice, that accompaniment would be a whole octave below him!

The truth of this is, however, firmly established, except in the minds of those few, who endeavour by sophistry, and a subtle mode of arguing, which, however, cannot bear the scrutiny of reason, to create a difficulty, by asserting that the note, A, (&c.) between the second and third lines of the stave, cannot be the note, A, which is intersected by the first ledger line above the stave! But if, when those two notes are sounded together, they so perfectly blend that every auditor, however exquisite sense of hearing, should not be able to cover more than one sound; and, that vessel, such as a rummer, &c. should equa... accord to either note, how can we say, that the octave is a distinct note. We admit it to be a distinct degree in the scale of sounds, but maintain, that they are, at least, as closely allied as the echo is to the voice! But, let us suppose that a house were built so completely like a model, that, when the former were diminished, by means of a suitable mirror, it should be so very perfectly similar, as not to be distinguished from the model; or, that the latter should be magnified so as apparently to equal the house itself in bulk; and that, in such states, they could not be distinguished; what would the fastidious critic, or rather sceptic, say? "that they were not the same!" True,—nobody would doubt it; but they would be as forcibly represented to the sense, that, if shewn alternately, without the deception being known, the spectator would be mentally convinced, that only one existed! We cannot, however, have a more satisfactory illustration of our position than by adducing the well-known fact, that all the instruments, of whatever pitch, used in a concert, and whether sounded by percussion, inflation, or collision, may be tuned from a common tuning fork, or by the given note of any instrument. We find also, that where a sharp, or a flat, is necessary in any part of the stave, the same is indispensable among all the parts, whether graver or acuter in their intonations.

Having established, we trust, in the most ample and substantial manner, that there are only seven sounds in music, we will now show the relation between them mutually, remarking, that, of course, every part of the scale must be affected in a similar manner as the octave we shall treat of, and which, for the sake of convenience, we shall select from the treble-stave, adding the tenor note C.

Example 2, represents what is called the extent of an octave; it is in the treble clef, as may be seen by the prefixed figure. The lowest note is C, the second is D, the third is E, the fourth is F, the fifth is G, the sixth is A, the seventh is B, and the eighth is C; forming a replicate of the first note, C. Each of the above notes is designated according to the manner in which musicians compute them, always reckoning the fi... te 1, the next to it a second, and so on ...ughout: thus E is the third to C, and ... is third to E, or fifth to C; always ...g from, and including the lowest ... In the above example, all the notes ... it is termed natural, ♮; because no ... ♯, or flat, ♭, is necessary, to give th... at relative distance which naturally pr... in the disposition of the eight prece... notes of an octave. This, however, onl... ppens when C, ♯, is the first, and ... ve the last note of the succession, ... ults purely from the above cause. This we shall explain. The notes do not all stand at equal distances mutually. The first interval, from C to D, is a whole tone; the se... ond, from D to E, is likewise a whole tone; ... rom E to F, is only a semi-tone (or half ... one); from F to G, is a whole tone; from G to A, is a whole tone; from A to B, is a whole tone; and from B to C, is only a semi-tone.

The above are the distances at which nature has placed the notes composing an octave in the major key; of which, as well as of the minor key, we shall treat amply.

If the notes, as thus arranged, be played on an instrument, or be sung by a well-tuned voice, they will be found to follow in a most pleasing manner. The smaller intervals, as they are called, between the third E, and the fourth F; and between the seventh B, and the octave, C; form the succession into two distinct periods, of which the former raises the expectation, while the latter satisfies it. We could not stop at F without disappointment; we should feel the want of some termination; whereas, at C, that termination is given; and we feel convinced, that we have arrived at a conclusion.

Such is the case in every octave of which

the key-note leads, and its eighth is the final; and so invariable is the succession of intervals we naturally expect to find in the major key, that every deviation therefrom distracts our attention, and sets the ear in search of that conclusion at which it never arrives. To prove this, let the lowest C, in the second example, be done away, and D be substituted above the upper C, as in Example 3: play all the notes natural, and the succession will not prove either pleasing or conclusive; because the order of the intervals is perverted. For, instead of the two first intervals being whole tones, the second (between E and F) is but a semi-tone; and in lieu of a whole tone between B, the sixth, and C, the seventh of the scale, there is but a semi-tone; and instead of a semi-tone between the seventh, C, and the eighth, D, there is a whole tone. Now, to remedy this, the third must be made to approach the fourth, and the seventh to approach the eighth: this is done by making them, *i. e.* F and C, both sharp; so that the distances between them and their next superior notes, should be reduced half a tone each; which halves of tones are thus added to the notes respectively, below F and C; and the whole octave is duly regulated; the proper intervals being established: this is called "giving a sharp third and seventh:" whereby a major key is indicated. The minor key has two variable notes; namely, its sixth and its seventh. In ascending, they are invariably played sharp, the same as in the major key (or rather mode); but in descending, they are played flat. Thus, in Example 4th, we take the key of C minor, which requires a flat third, a flat sixth, and a flat seventh. To affect this change, which gives a peculiar plaintive expression to the music, we are obliged to adjoin three flats (♭); namely, an E flat, to make the third so; an A flat, to depress the sixth; and a B flat to reduce the seventh to a full semitone below the eighth. See Example 4. The practical ear at once distinguishes the minor from the major mode: they may always be ascertained by counting the semi-tones included in the third: if the mode be major, there will be found five semi-tones; but if it be minor, only four. See Example 5th, where there are five; consequently the mode is major: in Example 6th, which has three flats prefixed, there are only four; therefore the mode is minor. The following table of sharps and flats is of the utmost importance to be thoroughly understood.

TABLE OF MAJOR KEYS.

C has neither sharp nor flat prefixed.
D has F and C, sharp.
E natural, has F, C, G, and D, all sharp.
E flat, has B, E, and A, all flat.
F natural, has B flat.
F sharp, has F, C, G, D, A, and E, all sharp.
C natural, has F sharp.
A flat, has B, E, A, and D, all flat.
A natural, has F, C, and G, all sharp.
B flat, has B and E, flat.
B natural, has F, C, G, D and A, all sharp.
C sharp, has every note sharp.

TABLE OF MINOR KEYS.

C has B, E, and A, all flat.
D has B flat.
E natural, has G sharp.
F natural, has A, E, A, and D, all flat.
G natural, has B and E, flat.
A natural, has neither sharp nor flat.
B flat, has B, E, A, D, and G, flat.
B natural, has F and C, sharp.

Example 15, shows the flats or sharps necessary for bringing the notes into their proper intervals, as has already been shown, according to what note may be selected for the key. Thus we see in the first instance two sharps, F and C, with the note D, whence we know the key, or mode, to be major: after the first double bar, we see two flats, B and E, whence we know the key to be E flat major. The order in which the flats succeed, in augmentation, is this: B, on the middle line of the stave, is always the first, because F is the first of the flat keys, and requires that B should be flat, to bring the notes to their proper intervals; for the next flat count a fourth upwards, and you have E flat, which, added to B flat, gives the letter for the key; again, count another fifth upwards, and you have A flat, making three flats with E flat for the key. The figures under the stave, at Example 16, show the order in which they thus follow and accumulate. The sharps proceed exactly the reverse, for they count downwards; thus F, being the first sharp, gives G for the key; for each succeeding sharp, counted by fourths down the scale, gives the note immediately above it for its key; therefore, counting the fourth downwards, we have C for the second sharp, and D for the key of two sharps: then, another fourth downwards, we find G, which, being the third sharp, gives A for its key; and, descending still another fourth, we have D

sharp, with E for its key. In this manner we see the succession of sharps marked in Example 17. *Minor* keys take the signs of the major keys, *one third* above them: thus B natural, *minor*, takes two sharps: which, by reference to the first table, will be seen to indicate the key of D major.

To elucidate what has been above said respecting the ascent and descent of an octave in the minor key, the reader is referred to Example 7th: it is in the key of G minor, with two flats, B and E. It is to be remarked, that a sharp, prefixed on the line, or space, of any particular note, implies, that all notes of that name, wherever situated, whether octaves above, or below, are to be played sharp: a flat has the contrary effect, causing all to which it relates to be played flat. A natural is applied either way; when prefixed to a note that should else be played sharp, it causes it to be played half a note lower; *i. e.* natural: when before a note that should else be played flat, it raises it a semi-tone, causing it to be played natural. Those signs of sharp, or of flat, which are prefixed at the commencement of the stave, govern throughout the piece; while those sharps, flats, or naturals, which are found interspersed among the notes in the music, indicate that only the succeeding notes of that name, contained within that bar, are affected thereby; for those in the succeeding bars would be played according to the key of the piece, unless such accidental signs should be repeated in them. Besides, accidental signs may be contradicted in the same bar; of which the chrometic passage, in Example 8th, will be a sufficient explanation.

There are various kinds of notes, all different in their elevation; and there are various kinds of rests, each corresponding with some one kind of note, directs a pause or cessation of sound, during such time as the note corresponding with such rest would occupy in playing, according to the measure. Example 9, shows the form of each kind of note in modern use. No. 1, is a semibreve, which, in modern music, is held to be equal to a whole bar of common time. No. 2, is a minim, equal to half a semibreve. No. 3, is a crotchet, equal to a quarter of a semibreve. No. 4, is a quaver, equal to half a crotchet. No. 5, is a semiquaver, equal to the fourth of a crotchet. No. 6, is a demisemiquaver, equal to the eighth of a crotchet: the rests, which correspond with these notes, are placed under them respectively. A bar may be made up of one semibreve, or of two minims, or of four crotchets, or of eight quavers, or of sixteen semiquavers, or of thirty-two demisemiquavers, or of any mixture of those notes, provided their aggregate does not exceed the value of four crotchets in a bar, for common time; or of three in a bar, for triple time. A dot, added after a note, causes it to be held half as long again as when not dotted. and when two dots are put, they lengthen the preceding note to three-fourths more than its original value; at 7, where a dotted minim and a crotchet make up the bar; at 8, a crotchet, a minim, and two quavers; at 9, a crotchet, four semiquavers, a dotted crotchet, and a quaver; at 10, only a semibreve. The commencement of Example 9th, is marked with a C, through which is a perpendicular stroke: this sign, either plain, or so intersected, means common-time of four quavers (or their equivalents) in each bar: when we see $\frac{2}{4}$, it implies, that there are only two crotchets, or four quavers, in each bar, as in Example 10th, in which every bar will be found to contain an equal measure of notes. When one or more notes are placed before the beginning of the first bar, such always are deducted from the last bar, and, with its amount, will be found to form a complete measure. At No. 5 and 6, in Example 9th, we see the notes in three several forms; the first are detached, the second four are tied, and the rest are all written in an abbreviated manner. The number of hooks, or strokes, affixed to the tail of a note, indicate its value: the more strokes, or ties, the shorter the note's duration: this will be seen also to affect the rests of all the shorter notes, in the same ratio with the notes they represent. Rests, being dotted, are equally affected as the notes themselves. Triple-time relates to all measures which contain three, instead of four, equal parts; and is usually known by $\frac{3}{4}$, marked at the commencement, if the measures be of three crotchets in a bar; but if of three quavers, then $\frac{3}{8}$ is prefixed, sometimes we have $\frac{9}{8}$, which implies nine quavers: this last is almost exclusively peculiar to Irish music. Regarding the above points, we refer to the explanations, No. 11, 12, 13: in the last, it will be seen that a quaver-rest fills the place of the quaver, wanting in the music to complete the measure. There is also a measure called $\frac{6}{8}$, which is generally called

compound common time, but which is, in fact, a species of triple time. The reason given for classing it as a common-time measure is, that the beat of the foot, *i. e.* its fall, is at the first note; and, that the rise of the foot is in the middle of the bar; whereas, in all kinds of triple-time, the foot rises at the third division of each bar. This is called beating time. The letters, *d* and *u*, put under the notes in the 10th, 11th, 12th, 13th, and 14th Examples, will show when the foot should fall (at *d*) and rise (at *u*). This operation is not necessary among good musicians; at all events, only one, that is, the leader of a band, should ever beat the time, and then only loud enough to govern those who accompany him. Those performers who cannot feel the measure will never be the better for its being beat into them.

Music is divided into periods and phrases, the same as poetry: it would be trespassing on the limits of our plate to insert examples of this; but every person, at all conversant in the practice of music, or who has a susceptible ear, cannot but notice in all ballads, and other lyric compositions, &c. particular dispositions in the musical phrases to assimilate with the lines or words. This is not so much felt in the more laboured compositions, in which we too often find, that affectation of singularity, and a display of science, lead the composer to deviate from the simple dictates of nature, and to carry his audience into those sublimer regions of composition, whither the vulgar are not prepared to follow him. Bravuras, and other highly-wrought compositions, are of this description: in such, the powers of some favourite performer are to be rendered conspicuous, and astonishment, rather than pleasure, is the momentary object. Such, however, essentially serve the cause of the science; for, without some points of emulation, we should be limited to ditties, dirges, and all the tribe of artless strains, which, though very pleasing in themselves, would form but an indifferent school, and by starving genius, and banishing taste, would reduce our whole stock of musical knowledge, and of musical recreation, to very narrow limits indeed.

But, although music may not be confined within the shackles of lyric intention, it nevertheless, if worthy of the designation, is, in every part, under the influence of general rules, applied, perhaps, with less rigour, and occasionally too much neglected; but such liberties often produce most powerful effects; and, by exacting applause from mankind in general, seem to command that indulgence which theorists would peremptorily negative. The great art lays in the adaptation! Here we must remark, that several notes of the scale have very peculiar effects. The key-note always impresses forcibly, and seems most familiar to the ear: it is also very bold and commanding: the third leaves an unfinished effect, especially when minor, in which mode it assimilates greatly with the fourth, which is peculiarly querulous: the tone of the sixth is mild; as is that of the second; both these seem to have no determined effect; but, if any thing, partake of a minor tendency; that is, they are more plaintive than commanding: the fifth is bold, but inconclusive, though it evidently points to a termination; hence we find, most pauses and imperfect cadences settle on this note, which, in many situations, seems absolutely to convey some question. A perfect knowledge of the effect of all the notes in the scale is necessary to the composer, who thereon founds his melodies, and the expression particularly applicable either to the incident or to the words. The sudden rise, or fall, of a semitone, produces the most extraordinary effects on many occasions: the former may be rendered extremely pathetic, though in general augmentations in the compass of thirds, fourths, fifths, and sixths, tend rather to roughen than to soften; while, on the other hand, their diminution, and especially of a seventh, from sharp to flat, occasions a melancholy and languid change, often of the key; which if their passing from a major to a minor mode is highly impressive.

We trust the reader is now prepared to enter on the discussion of that important part of the science called harmonic consonance, or the doctrine of combined sounds. This relates to what is termed harmony, or the performance of music in parts; melody being confined entirely to a succession of single sounds; such as one voice, or the sounds of a flute, or of any other instrument capable of uttering only one note at a time. Hence, when we admire an air, and find fault with the accompaniments, as being deficient in modulation, &c. we say, "the melody is pleasing; but the harmony is bad." This part of our subject relates to an immense variety, in the selection of which the greatest judgment is necessary; as will be seen from the following brief hints.

There is to every note a natural accom-

paniment of a third and fifth, which being sounded with it, forms what is called a common chord; the term chord, applying to all those combinations of various notes, whether pleasing or otherwise, which are intended to sound at the same time. The 18th Example displays the common chord of C, in its three positions; namely, with its fifth, G, uppermost; with its third, E, uppermost; and with the key-note, C, uppermost. When the chord is in the first position it is called erect; in the second and third instances it is said to be inverted; for then G, from being a fifth above, is a fourth below, and E becomes a sixth below; which is nothing more than an inverted third. The common chord is the parent of all consonances; but by the addition of a minor third (B flat) above its fifth, G, it changes its designation; being called the chord of the seventh, from which all the discords are derived. This chord, with its inversions, may be seen at Example 19. When another minor third (D flat) is added, above the flat seventh, the chord is then called the chord of flat ninth and seventh; of which the figure and inversions may be seen at Example 20th. But this chord, though often found completely filled in full pieces, requires, in general, some deductions, such as the omission of the third and fifth; so that the discordant parts may be more fully heard, and more sensibly devolve upon a perfect harmony; as seen at Example 21st, where the third E, and fifth G, of the chord C, are omitted, while the flat seventh, B flat, and the flat ninth, D flat, each fall a semitone into the perfect chord of F, C itself rises into F, and becomes the key-note of the new chord. This will serve to show, how discords are resolved, as it is termed, into concords.

According to the strict rules of composition, every discord ought to be prepared; by which it is meant, that it should be heard as a part of some concord, before it becomes a discordant note in the succeeding chord; after which it must, as we have just shown, fall upon some accordant part in the next following chord. Thus, we find, in what is called the perfect cadence, or completion of a musical period, as at Example 22, the note F is first heard as the key-note of a common chord; in the next chord it becomes the flat seventh of G; and in the third chord, it sinks one semi-tone into E; thus becoming the third of the common chord of C. But the ninth may be natural, and may resolve so as to become the octave of the next chord, while the seventh, which may also be natural, may resolve into the sixth; both, however, should be duly prepared: a reference to Example 23 will give a correct insight into the charge thus made.

In speaking of cadences, we should remark, that various kinds exist, of which only that called the perfect is conclusive; the others, namely, the imperfect, and the false, or interrupted, leave the ear in a state of suspense. The perfect cadence is formed by the common chord of the fourth, F, (to which a sixth may be added, thereby making the fifth a discord, and compelling it to descend one step in the following chord), then the fifth of the key, G, bearing a chord of s[illegible]venth, fifth, and third, which resolves into [illegible]he common chord of the key-note, C: this [illegible]ay all be seen at Example 24, where the lowest notes show the bass notes of the [illegible]ence, and the upper ones exhibit the se[illegible]al changes indicated by the figures un[illegible]he bass progression, as they proceed in [illegible]ir resolution. Observe, that the octa[illegible] above, or intermediate, are not figure[illegible] The imperfect cadence relates to that s[illegible]ng, for a time, which occasionally ta[illegible] place on the fifth of the key, introduced by the key-note, as seen at Example 25, where, though the cadence falls on G from C, yet we feel a kind of expectation, that the music will return to the key of C, and that G will be only a temporary key.

The false, or interrupted cadence, is made by the bass moving, at first, the same as in the perfect cadence, namely, taking the fourth and the fifth of the key as fundamentals; but in lieu of proceeding from the fifth to the key-note, it ascends only one step into the sixth, which being accompanied by its third and fifth, and eventually by its seventh, which was prepared in the preceding chord, forms a great contrast with that of the key-note, of which the ear was in expectation, may be seen at Example 26: it must be carried in mind, that the perfect cadence should always follow an interrupted one. But, whatever changes may be made, and especially in passing from one key to another, the greatest attention must be paid to preparing the ear for the variety, by the frequent or forcible introduction of some note, prominent in the chord of the approaching key, especially the fifth, which is always very distinguishable. Nor should the change take place, except according to the laws of modulation, whereby it is re-

quired, that the preparation of the new key should be rendered familiar and smooth, by means of some one or more notes which may appertain thereto: thus, in Example 21, we find the key of F is introduced without any harshness, because the fundamental note, C, is the fifth of the succeeding chord. The key of G is equally easy from C, as may be seen at Example 25, on account of G being the fifth of C. The chords of the fifth, and of the fourth, being so easily established from the key, are called adjuncts, they require not any preparation. The key of A minor may likewise be assumed, as it were, suddenly from the key of C, without offending the ear, because its common chord contains two notes, C and E, which are constituents of the chord of C. We also find but little objection to shifting from the key of C major to that of E minor, because the latter hastens notes in it appertaining to the common chord of C.

Music would be extremely insipid, were it not, that modern composers have shown with what excellent effect discords may be introduced: these serve to vary and to embellish passages, which would else be very tame, and nearly monotonous! Discords are like those bold shadows in painting, which serve to relieve the lighter parts, making them appear more brilliant and more conspicuous; they serve like a rich sauce to an insipid viand, to give an agreeable zest to what would be scarcely tolerable. They are generally furnished either by addition, as the added sixth to the chord of the fourth of the key; or by suspension, where, as in Example 27, the bass assumes some note contained in the chords of the second and fourth parts of the bar, while the treble keeps the sound of the former chord suspended. A chord, figured with $\frac{4}{3}$, is but a suspension of the third. The chord of the ninth is but a suspension of the eighth; the seventh often suspends the sixth, while the sixth is frequently found to suspend the fifth. The ninth, seventh, and fourth are often found, at the same moment, suspending the eighth, sixth, and third. We have another variety, called anticipation, exactly the reverse of the foregoing; in which the upper parts get forward into the harmony of a succeeding chord, in which the bass does not immediately join, but follows in the same way that it precedes in suspensions. This is not quite so common as what we have just detailed; but, when well conducted, is full as beautiful.

In former times, when music was less understood as a science, than it is at this day, the rules, or rather the licences for accompaniment were very limited, and confined the harmony to such a paucity of permutations, as would, among modern theorists, be considered bald and puerile. We should not tolerate such music; for the habits acquired, by frequently hearing compositions in which every possible change has been introduced, would render the inexpressive, tame, and monotonous accompaniments of those musicians, who were contemporaries with the celebrated Guido, (to whom the art is highly indebted), little more gratifying than a peal on an octave of bells. We are not, however, to suppose, that plain, simple, melodies are beneath the composer's notice, far otherwise, we could quote many little strains, in which every note is attractive, and which, when duly accompanied, give the greatest delight. Perhaps Pleyel's German Hymn may, in that respect, be considered as neat a specimen as could be quoted; in it we have all the suavity of religion, without any of the dull, tedious, or tautological circumstances which characterize a large portion of church music. The variations annexed to that pleasing air, are proofs of the composer's taste; while the presto which follows, and is upon the same subject as the hymn, gives a most agreeable termination, and is so managed as completely to change the character of the music.

The art of composition requires great genius, taste, judgment, a fine ear, and the utmost patience! without these, good music will never be produced. We should, at the same moment, studiously avoid that pedantic bias, too often received by men of the first abilities, whereby a certain stiffness, and deficiency of air, are sure to follow; few, indeed, have the happy gift of acquiring all the necessary attainments in the theory, and to preserve a pure taste for those lyric compositions which are so highly relished by the multitude. We have, however, seen a Rosina start from the brain of science! Yet, after all, it is frequently with some difficulty that the favourite airs of other nations gain admittance among us. With persons who can appreciate merit, and who can discover beauty, even among features which may not be very regular, foreign compositions are well received; but it appears to us, that the English (speaking of the multitude) have nearly as much partiality for a peculiar stile, such as the ballads of Dibdin, as the Scots have for their

reels, strathspeys, &c. In fact, almost all music may be considered as national; for in every country we find either a peculiar measure, a peculiar mode of accenting, a peculiar kind of expression, or some one or more peculiar circumstances, which at once give a designation to the composition. The Irish nine-eighths; the Scots reversed punctuation; the accent of the Polacca on a part of the bar we seldom, or never accent; the great simplicity of the English ballad; the *naiveté* of the French pastorale; the wild, yet impressive Hindostanee air; the graceful Italian canzonette; the trifling, but cheerful, air Russe; and a variety of others, establish a certain index of national character, at least as conspicuous, and as prevalent, as the features of their various inhabitants.

The notes used in music form a kind of universal language; for, being in general use, they are equally familiar to all civilized nations; hence it is not uncommon to see several persons, who can barely make themselves understood by speech, unite in a concert, and proceed in their several parts with surprising facility and precision. The Italians for a long time had the lead in this fascinating science; and, such was the rage for the compositions of Italian masters, that an immense quantity of music, composed by the professors of other countries, was ushered into the world with Italian indications; by which means they obtained a welcome, and sometimes a celebrity, that would probably have been denied them, had their origin been discovered. These circumstances occasioned the general use of Italian terms; which, in lieu of diminishing since other countries have been able to boast of their justly praised authors, appear to be even more prevalent than ever. The confirmed establishment of an Italian opera, at every great city, in the most polished countries of Europe, seems to have generated a *gout*, or a partiality for both the language and the representations of Italy. This has given rise also to many deceptions, particularly to the assumption of Italian names by the natives even of England. Such is the effect of opinion, that merit is sometimes obliged to disown her native soil.

We shall now furnish a brief Glossary of those terms which are commonly found in modern music, and explain a variety of little matters relating to the titles of pieces, to the degree of quickness, or of slowness, in which they should be performed, and such other minutiæ as could not have been introduced into the former parts of the subject, without breaking that connection which we have endeavoured to preserve, whereby to lead the reader, in a familiar manner, through the most essential explanations.

GLOSSARY.

A *sonata* is a piece of music for instruments only: these are now chiefly for the piano-forte, either with or without accompaniments for a flute, or violin, or a violencello; or, eventually, with numerous accompaniments.

A *cantata* is a piece set to words, and is often interspersed with recitative; some of these are medleys, and are very long.

A *motetto* is generally considered as church music, such as our anthems, hymns, &c. or any single pieces of a sacred character.

An *opera* is a dramatic poem, in which [illegible]y airs, of various descriptions, arising [illegible] the incidents of the piece, are sung to the accompaniments of a full orchestra. Su[illegible] as are performed at our Opera House are throughout musical, being wholly a succe[illegible]on of recitative, airs, duets, chorusses, &[illegible] performed in character. Opera also si[illegible]fies a work; as Opera VI.

A *burletta* is a comic opera, in contradistinction to the serious.

A *ballet* is a dance in character, which, however ridiculous, is admitted and applauded, chiefly on account of the excellence of the performance.

An *oratorio*, a sacred drama, of which the words are generally selected from the scriptures; they are performed during Lent at Covent Garden Theatre.

A *concerto* is a grand piece of harmony, generally on some given subject, with full accompaniments, which join only in the chorusses, though a select number of parts are allotted to accompany the instrument which is intended to be displayed. The principal instrument on such occasions is termed the concutante, as violino principale, or fluto concutante.

A *concutante* is intended chiefly to display one instrument, but not without allowing others to be brought into particular notice at times.

A *voluntary* is a piece of music usually resulting from fancy, an extempore effusion; it is not a regular performance, and is neither fixed to any particular key, nor limited as to time; these are sometimes termed fantasias, capricias, ricatatas, tastaturas, &c.

A *serenade*, or *serenata*, was formerly meant to denote nocturnal music, but is

sometimes prefixed to dramatic compositions, without any particular meaning; the term is nearly obsolete with us, though it occasionally occurs in novels, &c.

A *saraband* is a piece in three-fourth time, generally played slow, and in a dancing stile; it is nearly the same as our ball minuet.

A *fugue* is a piece wherein one or more subjects always appear to fly in some conspicuous manner, and to be followed by the several parts in succession. There are single, double, and counter fugues; the latter moving in an opposite direction to the others.

A *canon* is a fugue which always returns to its subject; so that the several parts perform the same passages in succession: a canon may be kept up perpetually.

A *solo* is a piece intended for the exercise or display of some particular instrument; though in its correct sense it is music in one part only, yet generally figured basses are annexed; and to a solo concerto, very full accompaniments are given; in these we usually see the most difficult passages for that violin, flute, &c. which leads throughout, and which should be supported with great delicacy and judgment.

A *duo* is a composition intended for two voices or instruments; these are also called duets; when replete with brilliant passages, intermixed in the two parts, they are dignified with the additional term of concutantes.

A *trio* is music composed in three parts, either for voices or for instruments; it is also a designation given to a second or alternate minuet.

A *quatuor*, or *quartett*, is music in four parts.

A *quintetto* is music in five parts.

A *sestetto* is music in six parts.

An *overture* is either incidental or periodical; the former relates to those rich pieces, for a full orchestra, usually preceding the representation of musical entertainments; the latter are intended for the same purposes, but not for any particular opera, and are suitable to grand entertainments, for the opening of acts, &c.

Sinfonia, or *symphony*, usually relates to the few bars of preparation which are played as a prelude to songs, &c. to prepare the audience, and to give the singer the proper pitch for his voice—little symphonies are also occasionally interspersed throughout, either as graces or as a relief to the singer, after exertion especially; they are, for the same purpose, added after every verse of a song. The word sinfonia is synonimous with overture when prefixed to a piece of many parts.

A *cadenza*, or *cadence*, is that flourish made arbitrarily by a vocal performer, or by a leading instrument, while the whole of the other parts stop, at a pause. The cadence is quite an *ad libitum* passage, and usually is not written; the performer being left to deviate according to fancy, and without restriction as to measure, or to any key; he may modulate to any extent; but, when he closes, must return to that note on which the cadence is founded. When cadences are written, they are never divided by bars, like the rest of the measure.

A *march*, or *marcia*, is a military air in common time, and in a pompous majestic stile.

A *gavot* is a moderately lively air in common time, commencing with a half bar.

A *caccia*, or *chase*, is usually in six-eighth time, in a hunting stile.

An *allemand* is a slow dancing air, in common time; in which the parts of the strain are always repeated.

The *hornpipe*, *rigadoon*, *cotillion*, *waltz*, &c. are various kinds of dances, in rather a slow time, so as to admit of much grace; while the jig, the reel, the country-dance, &c. are more active amusements, and require less finish from the dancing master.

The *minuet* is a slow dancing air in three-fourth time; but is now out of use, except at court, and formal entertainments. The minuets in overtures, &c. are now generally performed quick; some, indeed, are absolutely prestos. These have usually trios or alternate minuets annexed; after the performance of which, the minuet itself is always played through without repeats. These minuets are not restricted to any number of bars; but the dancing minuet is invariably limited to two stanzas or strains of eight bars each.

The *rondeau* is a piece in which the theme is often repeated, and generally forms the main burden; it always ends the piece.

Recitative is a peculiar mode of reciting words set to music in a kind of chant that partly allows the sense to be expressed; the accompaniment of a recitative is often very rich, though sparingly given, and requires the greatest judgment to execute with propriety.

Score is the notation of the several vocal and instrumental parts of a piece in various staves, one under the other, bar for bar; so

that the whole effect may be seen at one view, while each part occupies its own stave separately. The score is the manner in which the composer sets out the several parts; from it they are afterwards transcribed by copyists into the different books respectively.

Counterpoint is the art of arranging parts to any piece of music, taking them from a figured bass; though some expert composers form the bass as they proceed. To be a good contrapunctist, a thorough knowledge of harmony, of modulation, and of the effect of certain combinations, as well of instruments as of notes, are absolutely necessary. Many a person may possess very superior skill in counterpoint who has no genius for the invention of good melody. Above all things the contrapunctist must avoid consecutive fifths and octaves in the same parts; however, a perfect and an imperfect fifth may follow. The reader will easily comprehend what we mean by consecutive fifths, when we refer him to the sounds of the open strings A and D on the violin, &c.; these are fifths—now, if the finger be laid on those two strings, so as to produce E natural, and B natural, those two notes being also fifths, cannot follow in any two parts; for although fifths are the third stage of harmony (octaves being the first, thirds and sixths the second) yet, when two parts proceed in a parallel of fifths, one for instance playing A B C D, while the other plays the D E F G below, the effect is harsh and inharmonious.

We shall now state the regular degrees of slowness, and of quickness, in the execution of music, according to the directions given by the following Italian words, which are chiefly in use.

Adagio, adagio, very slow.

Adagio, slow, in an easy leisure manner.

Largo, or *lento*, giving full time to express each part of the measure.

Larghetto, not quite so slow as largo or lento.

Andante, with perfect distinctness, and moderately slow.

Andantino, not quite so slow as andante.

Allegretto, or *poco allegro*, or *vivace*, in rather a free manner, but not quick.

Allegro, moderately quick.

Presto, quick.

Prestissimo, very quick, in a hurried manner; in fact, as quick as you can follow the notes.

Commodo, according to your own convenience.

Spiritoso, or *con spirito*, in a spirited manner.

Con vio, with vivacity.

Brillante, in a gay, rich, ornamented, and brilliant stile of execution.

Agituto, in an agitated broken manner.

Siciliana, a peculiar pathetic manner of performing six-eighth time.

Pastorale, in a pastoral ballad stile.

Timoroso, in a fearful or timid manner.

Affetuoso, in a plaintive affecting manner.

Amoroso, in an amorous or tender stile.

Animato, bold and dashing.

Cantabile, in a singing manner, but not faster than andante, or an andantino.

Maestoso, or *pomposo*, in a majestic or pompous manner.

Grazioso, gracefully, this term is very often mis-spelt, whereby it produces a very different effect, being then

Gratioso, which signifies a harsh rough manner, and is peculiarly applicable to those scenes of acute distress, devastation, and phrenzy, which are occasionally represented on the stage.

Larmoyante, or *doloroso*, in a weeping sorrowful manner.

Piano, or *p*, or *pin piano*, or *pp*, these indicate a low soft manner; the word pia inclining to the extreme, in contradistinction to

Poco, which means only a little, or rather as poco allegro, rather allegro.

Forte signifies strong and firm.

Fortissimo, or *forte forte*, or *ff*, in the strongest manner.

Mezzo, signifies middling, as mezzo soprano, a middle soprano; or *mf*, mezzo forte, middling strong.

Dolce, soft and pleasing, as dolce expressivo, to be expressed in a touching soft manner.

Ma, but.

Non, not.

Troppo, too much.

Men, less, as menforte, less strong.

Quasi, rather, or like; "andante, quasi allegretto; ma non troppo." "Andante, inclining to allegretto; but not quite so fast" (as allegretto.)

Con, with, as con giusto, with taste.

Senza, without, as senza sordini, without sordini (or mutes.)

Crescendo, increasing in force.

Diminuendo, decreasing in force.

Accelerando, quickening in time, but gradually.

Rellentando, or *ritardando*, becoming slower, but gradually.

Rinforza, or *rf*, or *rinf*, to reinforce that particular note.

Assai, enough, as allegro assai, rather more than less than allegro.

Staccato, means to sound each note distinctly.

Loco, we sometimes see music marked to be played an octave higher or lower than octave minim; with a waved line over the passage to be thus raised or depressed, when the word loco, or a loco, directs the music to be played at that exact pitch wherein it is written.

Arpeggio is a mode of playing the notes of a chord in succession, so as to imitate the sounds of a harp; of this a specimen is given in Example 33, where the chord of C natural is arpeggioed in various ways.

Syncopation is a peculiar manner of diving (as it is termed) one note into another; thus, at Example 34, a bar appears to be made of one quaver, three crotchets, and one quaver; if these be all played as they are written, at the same time giving the whole a kind of half-slur, the syncopeted effect will be produced.

Appoggiatura is the introduction of a grace, not included in the amount of the measure in a bar; but which is to be deducted from the note to which it is connected by a little curved line, as seen at Example 35; the performance of which is explained at 36. In this example it much resembles a brief syncopation; the appogiaturas, and indeed all graces, are usually in very small notes.*

Tempo, or *tempo piano*, after accelerando, or retardando, or rellentando, this directs the music to be resumed in its original time.

Pause, or *point d'orgue*, marked by a semicircle, see Example 25, (above or below a note), with a dot in its centre, implies a rest of all the parts, or a cadence.

Tutti means that the whole band should join; as in the reinforcing parts of concertos, &c. Tutta forza means "with all your force."

Fin, or *fine*, shews where the piece, or that division of it, ends.

Da capo, or D C, means that you should begin again at the head of the piece, and proceed until you come to fine. This is one of the signs of a repeat, and is usually accompanied by a figure, resembling an S, with a stroke through it, perpendicularly, and with two large dots on each side, see 31; so often as you see this mark, it refers you to the beginning, or subject, or to such part as has a similar figure prefixed, and terminates either with fine, or with a point d'orgue, which in such case is a final.

There are various kinds of repeats, as follow; the single preceding repeat, see 28, is known by a strong double bar, crossing the stave, in the same manner as those single bars which divide the measure into equal portions, and dotted with two or more large dots to the left. The single succeeding repeat, is known by two or more dots to the right of the double bar, see 29. The double repeat is dotted on both sides of the double bar, see 30, and directs, that both the preceding and the following parts should be repeated. Whereas where the bars are dotted only to the left, only the preceding part is to be repeated; and *vice versa*.

Mostra, or *direct*, is placed in a half bar ending a line, to shew what is the first note in the next line, see 32.

Bravura means a highly worked composition, in which the vocal performer is expected to execute difficult passages, with great skill and propriety of expression.

MUSICAL *instruments*. Notwithstanding the great number of instruments in use, and the vast alterations that have within these few years taken place in their construction, yet we cannot boast of much originality; nor can we assert, that so much improvement has been made in this branch of mechanism, as the theory and practice of music have received since the time of Guido, or even of the justly famous John de Murio. A retrospect to ancient dates will convince the inquisitive reader, that what we now term inventions are, with very few exceptions, plagiarisms from the common practices of musicians, &c. at a very remote period; some may be correctly traced to several centuries before the Christian era. In describing the instruments in modern use, we shall deduce their respective genealogies, and shew that many, which by the best accounts we can obtain were in high reputation among the Greeks and other nations, have, like the secret of rendering glass malleable, been altogether committed to oblivion. Of a few we have, indeed, an imperfect idea, furnished to us by some antique medals, bearing figures of musical instruments now unknown; but of which only the form can be thus understood, their intonations remain concealed.

We shall endeavour to detail the various instruments, of which we are about to furnish a concise description, in such a man-

ner as may at once establish a regular system, and enable the reader to proceed with his investigation in a familiar and satisfactory manner. The first step towards this important point is to form them into classes, as follow:

First Class. Instruments of percussion, whether pulsatile, as a drum, or as a piano-forte; or plectrated, as a guitar, or a harp, or a harpsichord, &c.

Second Class. Instruments of inflation; such as the organ, trumpet, flute, &c.

Third Class. Instruments of collision; such as the violin, and the celestina.

Our plan will be, in the first instance, to describe those instruments which are now in general use, together with their modern varieties, and to point out the ancient instruments from which they appear to have originated. Thus, considering it to be the principal, and most popular of the first class, *viz.* of percussion, we shall begin with

The Grand Piano-Forte. This admirable instrument resembles the harpsichord in form, but its action and tone are far superior. Its wires run longitudinally along the belly, or sounding board, supported at about two-thirds of an inch distance by small low curved battens of beech, or other wood, on which are short pins firmly driven into the battens, for the purpose of keeping the wires perfectly parallel. These battens, which are called bridges, determine the lengths of the several wires; though the latter pass beyond them for some distance; being looped on at their further ends to stout pins, driven firmly into a solid part of the frame-work, and coming over that bridge which is next to the keys, with which it is parallel, and winding on a set of iron pegs; which, being driven deep into a solid block of hard wood, are turned either right or left by means of a small instrument called a tuning-hammer, and are thus tightened or relaxed at pleasure. The shortest wires are the thinnest, these lie to the right, and give the upper notes. The largest wires are to the left, and give the lowest notes: those between them are longer or shorter, according to their situation; their several lengths increasing as they approach towards the left side of the instrument; forming, by means of the bridges, which lay obliquely, a triangular figure. Each note has three wires, lying within, rather less than half an inch in breadth; these are equidistant, and proceed to three rows of tuning pins, so that the tuner cannot mistake as to which of the three wires he acts upon. The wires are chiefly imported from Germany; our artisans not having as yet acquired the mode of giving them a due degree of temper. Those of the higher notes are of brass, and commonly begin with No. 8, 9, or 10, gradually increasing in thickness until they reach the extent of about four octaves, when they give place to copper wires, which produce a deeper sound. A few years back, piano-fortes rarely exceeded four octaves and a half, or at most five; but, latterly, they have been very generally manufactured with what are termed additional keys; which extend the compass upwards from F in alt, to double C in alt. Mr. Kirkman, of Broad-street, Soho, further extended the compass downwards, from double F to double C, giving a greater and a much richer scope of brass. But such additions necessarily increasing both the size of the instrument and its powers, disqualifies those so constructed from adaptation to small rooms. To remedy this, grand piano-fortes have been made in a vertical form, so as to resemble book-cases, &c.; they answer well, but in general overpower a weak voice: their convenience is obvious.

The wires of the piano are made to sound by means of small wooden levers, called hammers, each of which has a rising projection at its end, covered with many folds of leather, so as to produce a clear tone. These hammers are impelled upwards by means of the keys, which being depressed by the fingers, and balancing on small flat battens, on which they are arranged and kept steady by strong pins passing through near the points of equilibrium; also having little knobs of pump-leather standing on stems of wire, at their inner ends, cause the levers to rise on the least touch of the finger, with a smart stroke, so as just to touch the three wires of their respective notes. The levers being fixed to a frame, parallel with the keys, by means of vellum hinges, return instantly to their places, and lay on a small parallel apron covered with baize, so that no rattling nor jingling results from their retrocession. These hammers may be distinctly seen when working, as they pass through a broad slit made in the sounding-board, the whole breadth of the instrument. At the inner extremities of the keys are small pieces of buff-leather, which take off the sound that would else proceed from their contact with the shafts of the dampers; which are contrivances for stopping the

tones of such wires as are struck by the hammers, so soon as the finger is taken off from the key. The devices for damping, as it is technically called, have been numerous; and their several inventors have never failed to uphold their own modes, as the *ne plus ultra* of ingenuity. It would, perhaps, be impossible to detail their several merits with any shew of utility to the reader, or with impartiality to the inventors: if, however, simplicity of construction, certainty of action, and facility of repair, may give a claim to pre-eminence, the common balance-damper may assuredly urge its pretensions to the palm. This is nothing more than a round stem, like a small cedar-pencil, which is crossed at right angles by a flat bar, one of whose ends is slit, so that it may be guided by a slender perpendicular pin, as it rises, in consequence of the key's pressure upwards; at the other end is a small piece of broad cloth, single or double, according ot the powers of the wire (the longest vibrating most forcibly). This little piece of cloth, by falling on the wire when the key is released, instantly stops the sound. The reader will, from this description, collect, that, when slow passages are played, the continuance of each note is in exact ratio with the time of the key's being kept down; and, that, in rapid passages, where the touches are light and transient, even defying the quickest eye to follow the movements of the fingers, the operation of the dampers must be as rapid as that of the hammers, else a confusion of tones will be heard.

Most grand piano-fortes have two pedals, one for each foot, communicating with the interior. One serves to raise all the dampers completely, which in tuning is a considerable convenience; the other serves to throw the whole of the key-frame to the right, more or less; by this means the hammers are slid at the same moment, in a body, about a quarter of an inch to the right; so as to quit either one or two, at pleasure, of the left hand wires of each note; and to strike upon only one, or two, as judged proper for the greater or less diminution of sound. Other pedals are sometimes affixed for the purpose of opening a kind of flat cover, like Venetian blinds, laying over the wires, thereby to allow more or less sound to pass. The sounding-board, or belly, is made of very fine narrow deals, chiefly imported from the continent, so closely joined that, in many, no line, or indication of junction, can be distinguished. This belly returns the sound, causing it to reverberate very forcibly. The long keys are exteriorly covered with ivory plates; and the semitones, or sharp and flat keys, are made of ebony: they stand higher, but are nearly two inches shorter than the keys of the natural notes.

The *Harpsichord* is of the plectrated species, whereas the piano-forte is of the pulsatile. The former resembles the grand piano-forte in every instance, excepting that, in lieu of hammers, it has jacks; which, rising perpendicularly, pass the wires, and by means of short pieces of stiff quill, projecting from their sides, displace the wires from their right lines, and consequently cause them to sound so soon as the quills have passed. The dampers of the harpsichords are on the jacks. This instrument is partly derived from the polyplectrum of Guido.

The *Square Piano Forte* is very different in form from the grand. It, however, has an action, or movements, nearly similar. Its belly is short, and the bridge, or the sounding board, is rather curved. In some the tuning-pegs, which are four or in a line, form a kind of column on the right; in others they are immediately beyond that bridge which is nearly parallel with the keys. Each note has two wires; those in alt, and, indeed, down to G on the clef-line are usually steel, from No. 8 to 12; the middle notes have brass wire; about half an octave of the bass part are furnished with copper; and the eight or ten lowest notes are of brass wire, on which a thinner wire of the same metal is wound in an open spiral manner; whereby a deep tone is produced. A patent has lately been taken out,* by a manufacturer in Golden-square, for bass notes formed entirely of spiral wires. This is founded on the principle of increased length giving an increase of tone: these bass notes are, no doubt, louder than those on the common construction, but it remains to be ascertained how far they can bear comparison with them in other essential qualities. The square piano-fortes are made with pedals, but not for sliding the keys and removing the hammers laterally. That could not be done to any purpose in this instrument; as the wires, instead of receding from the player in a perpendicular line with the keys, lie across at nearly right angles. One pedal is all that is necessary, namely, to raise the dampers while tuning. Many young ladies raise the dampers while playing, for the purpose of increasing the sound; they certainly suc-

reed; and, at the same time, produce an abominable jargon, highly offensive to a good ear; and, in general, a sure proof of the want of a delicate finger, and of judicious expression.

We have one species of the piano-forte of which the notes are formed by collision; this is the *Celestina*, whose remarkable soft and fascinating tones result from the passage of silken lines over its wires. The action of this instrument cannot easily be described in writing: we will, therefore, pass on to the consideration of the

Spinet. This is a plectrated instrument; its shape is not much unlike a harp laid horizontally. It is cased the same as a piano-forte: the notes have double wires, almost wholly of steel, there being but few of brass: they are touched by jacks, as in the harpsichord; and, like it, the tones are very wiry and rough. Its compass is rarely more than four octaves, or at most five. This instrument is completely out of vogue; such as we now see are, in general, from 25 to 50 years old. It evidently was the parent of the harpsichord, as that was of the several kinds of piano-fortes.

Beyond the spinet we find the *Virginal*, which for a long time stood its ground. The citole, which was a little box, with wires on its lid. The magadis, which had its notes tuned in octaves. And the clarichord, or dumb-spinet, which was much used in nunneries, having its wires wound round with silk; it yielded a peculiarly soft, but low sound. This instrument seems to have been in vogue for a great while; though now extremely scarce, and only to be found in religious institutions on the Continent.

We must do the English manufacturers of the present age the justice of saying, that, for power and clearness of tone, freedom and certainty of motion, elegance of finish, facility of touch, and standing in tune, they stand unrivalled throughout Europe. The names of Tomkinson and Kirkman, for grand pianos, and of Clementi and Broadwood, for square pianos, stand eminently conspicuous in this branch of mechanism: but to obtain excellent instruments, even of their make, application should be made to them, and not to the paltry retailers of a few; which, though made by those manufacturers, are of a very inferior description, suited to the low prices paid by such advertising gentry.

The *Harp* next claims our notice: its form and manner of performance being so well known, require but little description. The name of this instrument is supposed to be derived from the Arpi, a people of Italy, to whom its invention is, by many, attributed; though others assert that the Arpi received it from the Irish. The Hebrew harp was said to be remarkable for its beauty, and for the great extent of its scale; the latter was supposed to surpass that of the modern harp, which does not exceed five octaves. Ours is always tuned to the same pitch, generally E flat, and its semitones are made by a number of pedals, placed round the base, or plinth, on which it stands: these communicate with the top-piece by means of a hollow column in front of the strings; on being pressed by the foot they cause the strings (which are chiefly made of what is usually called cat-gut, the gravest being of flock-silk, covered with fine wire) to be shortened by projecting stops, and thus to give a tolerable chromatic effect. The Irish, and the Welsh, used to be famous for their performance on the harp; but, at present, only a few itinerant bards are to be found in those countries: these preserve the tradition of many very appropriate national airs; but their execution is not to be compared with those of our great masters: nor are their harps to be rated with those superb instruments made by our best manufacturers, Evard, Erat, &c.

The antiquity of the harp appears to be as remote as it is certain. The psaltery, called by the ancient Hebrews the nebel, seems to have been a kind of harp. The simi-cum, of the ancient Greeks, was of this species also. The epigonum was of very ancient date, beyond what we can trace: it had forty strings; but its scale is certainly lost. The tripodian, invented by Pythagoras the Racynthian, was a species of harp, on which three different keys, or modes, were prepared: by turning the tripod round with the foot, either side could be presented to the performer, who changed his key at pleasure. A vase at the top answered the purpose of a sounding-board.

The *Guitar*, or *Cittern*, is much in use among the Spaniards, and their neighbours; it was also in vogue with us many years back: when some improvements were made, particularly the addition of six keys, corresponding with the six wires, these were called boxed guitars, and by some, piano-forte guitars. The instrument, as we see it in England, has a broad neck, on which are various frets, made of wires, fixed into the finger-board, at right angles with the

wires; these being the guides for the fingers to make the several notes, by pressing between the frets: the bridge is very low, and stands behind a circular sound-hole, covered with an ornamented and perforated plate: the body of the guitar is of an oval form, the sides perpendicular to the belly and back. This instrument is strung peculiarly: the upper open note, G, is of double steel wires, about No. 4; the second, E, is also double, No. 5; the third is of brass, double, and gives C; the fourth is double, of brass, and gives G, an octave below the upper wires; the fifth is E, an octave below the second wires; and the sixth is C, the octave below the third. The two last are single wires, covered with very fine wire, closely as possible, like the fourth strings of violins. The wires loop at the bottom to little ivory studs, and at the top to small steel studs, moving in grooves, each of them winding up with a watch-key, so as to put them in tune respectively. The Spanish guitar is strung with cat-gut partly; but the lower notes are, like those of the harp, made of floss-silk, covered very closely with fine wire.

There has been a late invention of what is called a *Harp Guitar*, but it does not seem to merit the name of an improvement. The compass of the instrument is increased by some long strings; but it appears to us, that the simplicity which is the characteristic of the guitar, is thus unnecessarily violated. We have few, if any, makers or performers of note in this branch; though some ladies sweep the notes with considerable grace and effect. The plectrum is out of use; the thumb and fingers of the right hand touching the strings, while the fingers of the left move among the frets.

This genus of instruments includes an immense variety, chiefly of very remote antiquity; the name of the guitar, we are confident, was borrowed, not as some assert from the Spanish, nor from the Latin cithara; but from the very ancient Hindu word sittarah, or sittar, which exclusively applies to an instrument with a very long neck, and mounted with four very small steel wires passing over a low bridge, that stands on a piece of tough untanned sheep's skin, spread over the surface of half a gourd or callibash. We have every reason to suppose the sittar was unknown in Europe until Alexander visited India. The scale of the sittar is very confined, though the performers do not neglect the scope given by the neck, which is nearly a yard long, and about an inch and a quarter in breadth, to produce many very unpleasant notes, high in alt, on the first wire: sliding their forefingers up as high as they can reach, and shifting with one finger only, among the frets, which are extremely numerous. The octachord, or lyre, of Pythagoras, had but eight notes; the pandoron was also of the lute kind; the bandora was the same; the chelys was more like our modern guitar; the theorbo, or arch-lute, is still in use in Italy, and seems to have been the basis of the harp guitar before mentioned. It has, however, two necks, of which the longest is appropriated to the bass-notes: if we are correctly informed, it is extremely difficult to perform well on the therbo; but the sweetness of its tones compensates for the trouble of attaining perfection. The lute much resembles the guitar, and is supposed to be equally ancient; it has six rows of strings, and is performed like the rest of this genus.

The lyre is held to be even more ancient than the sittar; though we have little or no information whereon we can depend, as to its scale, or its mode of performance. This instrument is seen on many ancient coins and statues, especially of Apollo. We have several fabulous accounts of its origin, and of improvements in days of yore; but we cannot take upon us to follow the tract of a long list of heathens, to whom much merit in this particular has been ascribed, since no benefit or particular gratification would result to the generality of our readers, nor would the instrument be better described, for it is a known truth, that all our acquaintance with it is from representation only.

We now come to the *Dulcimer*; it is nothing more than a small triangular flat box, in which is a shallow sounding board, having two bridges that approximate to each other as they retire from the performer. Over these bridges the wires are stretched in the usual way. The mode of performance is by means of two little sticks, armed with small knobs, partly of cork, and partly of hard wood, so as to make the tone more or less soft; it is at the utmost but a low sounding instrument, though of a pleasant tone. The scale is various, but commonly about three octaves; some have double wires. The people of the northern parts of Hindostan have a kind of dulcimer made of flat steel bars, varying from two feet to only a few inches in length; these are all fixed by means of wedges into a slit between two battens, and protrude hori-

zontally over a small box, which serves as a sounding board. The note of each is necessarily fixed, so that this instrument is always in tune. The sounds are produced either by a kind of plectrum, applied to the ends of the bars; or they may be touched by small knobbed sticks. Many of the natives in that part perform the common airs of Hindostan very pleasingly on this kind of dulcimer. The tones are not unlike those of very small chimes. The sticcado, or rigots, is of this species, and consists of a long wedge formed box, at the bottom of which two ridges are made longitudinally; on these narrow flat pieces of sonorous wood, of glass, or of metal, flat below and arched above, are placed, side by side, but not in contact; so that, the longest pieces from the lowest notes, gradually becoming more acute, as the pieces are shorter towards the narrow end of the box. The notes of this instrument are produced like the former: the scale varies; but rarely exceeds two octaves and a half. The tones are peculiarly articulate, whence many have erroneously called it the stoccato; and as it was formerly much in use among rustics, who could easily construct the whole apparatus, the additional designation of pastorale was given.

The *Musical-Glasses*, when touched with sticks, resemble this instrument more than any other. The glasses are of various sizes, according to the grave or acute notes they are to yield. Some sets are well in tune, but others require to have more or less water poured in, to bring them to their proper pitch. Some performers execute difficult pieces with wonderful adroitness, though but very few can produce the rim tone, *i. e.* by touching the rims with their finger's ends, so quick, and so effectually, as to vie, in point of execution, with the sticcado mode. The cistrum, or citron, was an instrument of this species, formerly in use among the Egyptian priests; we do not know sufficient of it to give any particular description; though it appears to be the parent of this genus.

Bells, *Chimes*, *Carillons*, &c. also appertain to the class of percussion, they being all struck, either by clappers suspended within them, or by hammers from without. We have some excellent bells in various parts of England; but very few chimes, and those few so vilely regulated, as to become a disgrace to their keepers, and a nuisance to the public. On the Continent the chimes of many churches are objects of admiration. We may often be well entertained with the carillons, sometimes suspended over the cages of squirrels, &c. which being touched by small projecting wires on the circular cage, the same as is done for notes on a barrel-organ, produce a pleasing effect, especially when they either, are touched in succession, like a peal of bells, or are made to perform some little air.

The most sonorous instrument of this class is the *Gong*, in general use throughout China, and occasionally to be seen in other parts of Asia. Some of these immense, round, flat masses of bell metal, or other mixture, measure nearly a yard in diameter, [illegible] eigh seven or eight hundred weight; [illegible] e, indeed, heard of them much larger. [illegible] till day, their sounds may be heard f[illegible] wo to three miles, very distinctly. [illegible] thor of eminence observes that the [illegible] f the gong cannot be appreciated; [illegible] ough we admit the difficulty, we m[illegible] bserve, as has already been remarked unde[illegible] the head of Music, that every atom in n[illegible] re, when at liberty, and not damped by [illegible] tact with others, possesses some particu[illegible] sound, replicating to some division on our scale. The gong is struck with a wooden hammer. We may consider the modern cymbals as a species of the gong; these are two plates of mixed metal, of various sizes, but generally near a foot in diameter, and about the sixth, or fifth, of an inch in thickness; cupolaed in their centers, for about three inches, so as to resound forcibly, and to fit into each hand of the performer, who usually strikes them in a passing manner to only the first and third notes of the measure. The effect of a pair of cymbals in a military band is grand; it is a powerful reinforcement to the accent, so as to render it almost impossible for the soldiers to step out of time; but, heard at a small distance, cymbals are distressing to a well-tuned ear; they are seldom if ever of the same intonation; and, when clashed together in the usual mechanical manner, yield a harsh and distracting sound. The nakokus is a kind of cymbal, which, hanging in pairs near the altars of the Egyptian churches, are clashed together to beat the time. The Asiatics in their bands, and in their religious ceremonies, use diminutive cymbals; not more than three inches in diameter, and rather bell-shaped.

Of the *Drum* species we have an abun-

dant variety. The side or military drum is well known; it is monotonous, but habit has so far reconciled us to its uses that we consider it as a musical instrument, though it is not in strictness entitled to that designation; nor is any instrument of this description to be so classed, excepting the kettle-drum, or timbale, which being regularly tuned, the one to the key note, and the other to its fourth below or fifth above, are satisfactorily and efficiently introduced into full bands, in which their emphasis, their powers, and their thundering roll, frequently prove very acceptable aids, and produce the richest effects. The kettle-drum derives its English name from its form, the bottom being a large semispherical kettle of copper, and the head being of velhum stretched on a metal hoop, which being lowered or raised at pleasure, so as to vary the internal measurement, can be tuned precisely to any given intonation. They are accounted bass-instruments, on account of their grave sounds. Though our cavalry, for many years, were generally provided with kettle-drums, yet they were not of our own invention; nor were they known in Europe before the holy wars; when they were first adopted from the Saracens, or Moors, who were accustomed to carry them, of immense bulk, suspended on either side of camels; the driver beating as the animal moved on. The Asiatic princes consider the kettle-drum as the indication of royalty; or, at least, of pre-eminent rank and power; accordingly the naugaurah, or nagarah, is even to be heard in the kobats, or musical balconies, over the gates of princes, and in all state processions: it is likewise used by the priests of the Mussulman religion, to announce the hour of prayers, &c. The designation, *i. e.* naugaurah, is to be found in Hindu manuscripts of a much older date than any of our European records, or authenticated traditions. The musicians of Hindostan likewise use a very small pair of kettle-drums, with wooden bottoms, which they call taublahs; these are fixed in the cloth they pass around their waists, and are beat with three fingers of each hand, in a very peculiar manner, and producing very curious effects, according as the fingers are more or less protruded towards the centre of the taublah. Their note, as in our side drum, is perfectly adventitious. The bass-drum, by many called the Turkish-drum, is very large, and usually carried crossways before the performer, who beats one end with a short club, having a large knob at its end; the left hand is provided with a lighter stick, or a bunch of split rattans, &c. so as to vary the sound considerably; but only the right hand beats upon the accented parts of the measure. This instrument is derived from the Indian long-drum, called the dole, which, instead of being cylindrical, is of a barrel-form, contracting much towards the ends, which are covered with raw skins of different thickness; no stick is used, the performers beating with their fingers.

The *Tabor* is a small drum, so flat, that the two heads are not more than three inches asunder. It is only used as an accompaniment to the pipe, for dances, &c. The tambourine is a kind of drum with only one head, the other end of the hoop, which is not more than four inches in breadth, being open; the head, which is of the best parchment, is fixed to an iron rim, and by means of screws fixed to the exterior of the hoop, can be tightened at pleasure. The performer puts the thumb of his left hand through a hole in the hoop, lined with an ivory, moveable bush or box, to prevent chafing. In this manner he whirls the tambourine about, and makes the brass jingles, or cymbals, (as they are called) which are inserted in pairs, through slits in the hoop, strike so as to produce various sounds, either clashing or tremulous, according as he may apply his right hand. The performer should have plenty of well pulverized resin, strewed on the face of the tambourine, so that when he rolls, by means of the tip of a finger being rubbed thereon, the instrument may sound well. The military tambourines have generally an iron bar across the interior, furnished with bells of various sorts and sizes. This instrument was for some years much in vogue among the English ladies, as an accompaniment, jointly with a triangle, for the piano-forte. It is not easy to account for so heterogeneous an assemblage, unless in the opportunity afforded of displaying symmetry of form and graceful action. The good sense of the sex, however, speedily dismissed so absurd a combination, and allowed our ears to be again delighted with the purity of harmony, supporting the melody of a fine voice. Though the term tambourine would imply it to be of French invention, and to mean only a little drum, we are rather disposed to believe it originated in the coonjery, which is extremely like it, though smaller, and has been in common

use throughout Asia for centuries, and which probably received its designation from being always employed among a tribe, called the Coonjoors, or Sampareahs, who get a livelihood by catching and shewing snakes. It is beat with the fingers of the right hand; and in possession of a good performer yields a variety of intonations, far from disagreeable, and partly caused by the pressure of the fingers of the left hand, by which it is held. This instrument rarely exceeds nine inches in diameter, nor is the hoop usually more than three inches broad, generally less; the head is either of bladder, or of raw kid-skin, scraped extremely thin. The ancients had drums of various descriptions; such as the timbrel, which appears to have much resembled the common Asiatic long-drum, or dole; and the minaghinim, which cannot be classed with any other instrument, it being a hollowed board, over which a chain was stretched, and which passing through balls of iron, &c. was beat, and swung round, so as to occasion a deafening noise.

The *Triangle* is a round steel bar, about the third of an inch thick, made into an equilateral triangle, and beat with a little piece of the same metal; it forms a passable accompaniment in a military band, and in country dances seems to give a life to the music. It appears to be of a very ancient invention, though revived only within these few years.

The *Castagnet* was originally made of two hollow chesnut shells, which being connected by a string passing round the outside of the middle finger, were rattled together according to the measure, while dancing, each hand having a pair. Castagnets are in general use among the Spanish women, but instead of chesnut shells, as their name indicates they should be, they are now commonly made of sonorous wood. There is another kind made of small shin-bones of animals, of which one being held between the fore and middle fingers, and another between the middle and third fingers, they are rattled together for the same purpose.

We believe these to be all the instruments of percussion known to us, excepting, indeed, some of the most trifling, which do not merit a place in this work. The next class, namely, instruments of inflation, now comes under consideration; the principal of these is

The *Organ*, an instrument of the highest antiquity, in the structure of which the greatest ingenuity has been displayed. The reader cannot expect to find here a detailed description of so very complex an instrument; but we shall endeavour to afford such a perspicuous and general outline, as may exhibit the principal parts sufficiently for his purpose. The most difficult to make properly is the wind-chest, which is an extensive, horizontal box, so closely fitted and prepared, as to retain the wind impelled into it by various large bellows, which must be numerous, and capacious, in proportion to the size of the wind-chest. The quantity of wind in it is always known to the organist by means of a tell-tale, or index, which rises and falls in proportion thereto. The top of the wind-chest is bored with several lines of apertures, proportioned to the sizes of the pipes they are to receive, those of the bass notes being the largest; but all the pipes in each row being different as to their interior construction, and consequently producing very different sounds; each row is called a stop, and has a plug appropriate thereto, acting upon a slide, which shuts or opens the whole of that row at pleasure: this is called a register. There are as many of such rows of apertures or registers, as there are kinds of tone or stops on the organ: some having few, others having numerous stops. The wind is prevented escaping from the wind-chest into the pipes, by valves, which are opened only when the performer presses the keys respectively; when, by means of communicating wires, the valves are pressed down, and the wind passes into the pipes. When the key is quitted, the pressure of the wind, aided by a spiral wire spring, shuts the valve, and the sound of that pipe instantly ceases. In order to regulate the force of the sound, most church-organs have either two or three rows of keys, whereby a greater or less number of pipes may be filled, and the powers of the instrument be controlled into what is called the small organ, or be let loose so as to become the full organ. The pipes suited to the higher notes are made of mixed metals, chiefly grain tin and lead; they increase in length and diameter in proportion to the note, until, metal pipes being no further applicable, square ones of wood are substituted in their stead for all the lower notes. The dimensions of all the pipes of an organ are regulated by a scale or diapason, formed for the use of manufacturers in this line, and apportioned to every size of instrument usually made. Many designate the organ

according to the length of its lowest note, *i. e.* a sixteen, a twelve, or an eight foot organ, such being the dimensions of the main wooden pipe. Some organs have been built on the Continent whose powers were immense, causing the largest cathedrals to vibrate sensibly with their sounds. The following are the stops usually made in a great organ: The open diapason, in which all the pipes are open at the top; this is a metallic stop. The stopped diapason; the bass notes of this, up to the tenor C, are always made of wood, and are stopped at their summits with wooden plugs, whereby the tone is very much softened. The principal is the middle stop, and serves, when tuned, as the basis for tuning all the other parts, above and below; it is metallic. The twelfth is metallic also, and derives its name from being a twelfth, or an octave and a half, above the diapason. The fifteenth, so called, because it is two octaves above the diapason. The sesquialtera, composed of various pipes, tuned in the parts of the common chord; the upper part is often called the cornet. The furniture-stop is very shrill, and in some passages has a peculiar fine effect. The trumpet is a metallic stop, and derives its name from the instrument it so admirably imitates: this peculiar tone is produced by means of what is called a reed, but is in reality a piece of brass, on which the wind acts forcibly, giving a roughness to the sound, which is further changed by all the pipes of this stop, having bell mouths like trumpets. The clarion is a reed stop also, but an octave higher than the trumpet; it is only suited to a full chorus. The tierce is only employed in the full organ, it being very shrill, and a third above the fifteenth. The octave above the twelfth is too shrill to be used but in the full organ. The cornet is a treble stop. The dulcimer takes its name from the sweetness of its tones. The flute is named from the instrument it imitates, as are the bassoon, vox-humana, hautboy, and cremona, or krumhorn, stops. The proper adaptation of the several stops in the performance of sacred music, and in accompanying a choir, requires both judgment and experience. The fingering of an organ is precisely the same as that of the piano forte, so far as relates to the situation of the keys, &c.; but on account of the great number of holding notes in organ music, the fingers are more kept down, whence it is considered highly injurious to piano forte performers to practise the organ, they being subject to lose that lightness, and that delicacy of touch, required for the former instrument.

Organs are likewise made without keys, but with barrels, on which are a great number of pins and staples of flat brass wire, and of different lengths. The barrel being turned by means of a crank or winch, the wires that communicate with the valves in the wind chest are acted upon by the pins and staples; which hold down the valves for a longer or a shorter time, according to the duration of the notes they respectively govern. On these barrels, which are made to shift at pleasure, from ten to fifteen tunes are usually made, by the foregoing means. The winch not only turns the barrel, but also works a pair of bellows, by which the wind-chest is supplied. This instrument is called the hand, or barrel-organ, and is very common in our streets. See ORGAN.

A very small sort is constructed with only a couple of octaves, or less, the whole apparatus fitting into a box little longer than a mahogany tea and sugar chest; this is called a bird-organ; its notes are peculiarly melodious and soft; much resembling those of the flageolet. All bird-fanciers keep one or more of this description, for the purpose of teaching canaries, bullfinches, &c. to sing popular airs.

The *Mouth Organ*, or *Pan's Pipes*, are well known; being so often played as an accompaniment to organs, &c. in our streets. They are of various sizes and extent; some being nearly three octaves; a few have a chromatic scale, at least for the adjunct keys; *i. e.* those of the fourth and fifth. The tones of the mouth-organ are certainly agreeable, but are best heard at a distance; when, either as an aid to the organ, or performing pieces arranged for several mouth-organs, as is very common, they have a very pleasing effect; when played in a room, the notes are very piercing, and the sibilations are highly offensive. The antiquity of the mouth-organ seems to be fairly established; it is to be seen on most ancient coins, relating to music, and above all to Pan, from whom they derived their name; that fabulous deity was usually represented with his "pipe of unequal reeds in one hand, and a shepherd's crook in the other." The simple construction of the instrument renders it highly probable, that it is of much older date than we can trace; but we may reasonably feel some surprise, that the great organ should have to boast of existence even many cen-

turies prior to the birth of our Saviour. Organs were supposed to have been invented by Ctesbius, but as to their construction we are left under great doubts; all we can discover is, that they had many pipes, into which the wind was impelled by water. A modern author seems to infer, that the air was acted upon by water, so as to be compressed, as in the air vessels of our fire engines. This, though a plausible mode of solving the doubt, does not prove completely satisfactory, because we have strong reasons for concluding, that the ancients were not acquainted with that part of our pneumatic practice. The air-pump was not known until Otto de Guericke, a consul of Magdeburgh, exhibited his invention before the Emperor, and the states of Germany, in the year 1654; and the fire-engine was first invented by Zachary Greyl in 1721, improved upon by Doctor Godfrey, and gradually brought to perfection by the successive additions and inventions of Moitrell in 1725; Jacob Leufold, ditto; Neevsham in 1744, &c. &c. We are rather inclined to believe, that the air was acted upon in the ancient keras, or hydraulic-organ, much in the same manner as in the French smelting furnaces, *i. e.* by water falling down a long pipe, and dashing on a large stone, placed in the centre of a small chamber at its bottom; whence the air thus drawn down by the stream or succession of dribblets, rushes into the furnaces with a violent and equable current. Whatever the mode might have been, the practice of constructing organs, whose sounds proceeded from some hydraulic apparatus, appears certain from the many records all tending precisely to the same point. The performers were termed asculæ. Plato, and Proclus his commentator, mentions a wind instrument in use among the Greeks, which appears to have borne a strong resemblance to the modern organs; it was called panarmonium, and was so contrived, that every aperture was capable of yielding three or more sounds. The magrakitha, of the ancient Hebrews, was likewise an instrument composed of various pipes, fixed in a chest, open at top; but closed at the bottom, where they had small perforations, communicating with a wind tube, into which the performer blew; stopping those pipes that were not to sound with his fingers. In the foregoing references to remote antiquity, we discover the basis of our majestic instruments; but the swell, which, by means of a slider, augments or smothers the sounds at pleasure, is the invention of modern mechanics, who have entirely brought the organ to wonderful perfection.

The *Eolian Harp* may be best included in this class; though it cannot, in every particular, be arranged therewith. It consists of a long box, in which four or more strings are stretched for its whole length, and tuned to the component parts of any common chord, such as C, E, G, C, E, G, &c.: opposite the line of the strings which stand over a slanting sounding board, are two slits, one on each side, running parallel with the entire strings. This instrument being placed opposite to a window, opened only an inch or two, the air will rush through the slits, and vibrating upon the strings, in its passage through the box, will cause a kind of tremulous murmuring repetition of the various notes. The Eolian harp is by no means a disagreeable companion, when perfectly in tune. Some idea of its notes may be formed by stretching a thin violin string over the narrow slit between the upper and under compartments of a sash window; these being generally rather open, allow the wind to pass, and will cause the string to keep perpetually humming that note it yields when plectrated or touched by a bow.

The *Trumpet*, with all its tribe, now comes under consideration. This most audible instrument is made of metal; those of silver are by far the softest in tone; but brass is in general used. The modern trumpet is very short and portable compared with the old form of the instrument; its tone or pitch is varied by means of additional pieces called crooks, by which it may be made to accord with any given key-note. It has a mouth piece, which is about an inch in diameter, concaved for the lips to act within, and closing into a very narrow tube, through which the wind passes, with considerable force, into the neck of the instrument. The trumpet is a treble instrument; but, excepting from C in the middle of the stave to its octave above, can only perform the three under notes G, E, C, and G in the bass; in the above octave it can only deviate from the key C, by a sharp fourth, leading into the key of G. In saying this we speak of the instrument unaided by the hand; for by various modes of fingering within the bell, or mouth, the trumpet can be made to yield a great variety of semitones. Trumpets with slides, which suddenly lower or raise the pitch one or two notes, are capable of great execution, and

may be made to yield every note and semitone within their whole compass, so as to go through all the intricate passages of solo-concertos; but to perform in such style, and, indeed, to manage the slides with tolerable accuracy, requires a faithful hand, and the greatest promptness. We have heard that some performers can reach to G in alt; and, by a peculiar mode of forming the mouth-piece, perform duets; playing two distinct parts. We have heard this done upon a French horn, with surprising distinctions and perfect intonation. Within these few years a new instrument of the trumpet species has been introduced into full bands; this is the trombone, of which there are various intonations, viz. the bass, the tenor, and the alto. They all have their appropriate uses, and in some passages produce a very grand effect; especially in serious pantomime, and such passages as demand the greatest exertion on the part of the band. We are, nevertheless, obliged to acknowledge, that in too many instances we have heard the too forcible notes of the trombone, too powerfully and too indiscriminately uttered. Composers should consider this instrument as the *Ultima Thulè* of those grave sounds which seem to be travelling towards the lowest abyss of musical profundity. They should also recollect, that the performers on this potent tube rarely take it up except to give the utmost emphasis to some strong marked passage; whence they conclude it necessary to out-Stentor Stentor, and absolutely "to split the ears of the groundlings." It does not appear possible, that the trombone can, like the trumpet, be played with a sweet soft tone, not louder than a flute; from all we have heard it is, even when in the best hands, harsh, and almost unmusical.

We have various sizes of trumpets, some intended for concerts, and of course furnished with crooks; others are in use in our cavalry, made short and compact, and invariably pitched to one key; it is not unpleasant, though rather uncommon, to hear the trumpets of a cavalry corps, sounding their several calls in parts; though the harmony is not varied, there is yet a something in it that reconciles us to its narrow limits, and indeed to the imperfectness of many reputed concords; few of which can be sounded correctly on trumpets. The sackbut, formerly in use among the Hebrews, and which is so often mentioned in scripture, was the basis of the modern trumpet; and, like it, could be lengthened at pleasure, so as to accord with other instruments. The clarion was a small trumpet. The Hebrews called their sacred trumpets keranim.

The next in this class is the *French Horn*; of which we have various sizes and descriptions. Those intended for concerts have, like the trumpet, various crooks, and a slide, whereby they may be brought to accord with the most scrupulous exactness. The horn always has its music written in the key of C, and acquires any other key at pleasure, by the addition of such crooks as may bring it to the proper pitch: the more crooks are affixed, the deeper will be the intonation. There is a very strong affinity between the horn and the trumpet, in regard to their capability of producing particular notes; what has already been said of the latter, in that respect, applies equally to the former. The finest notes of this instrument lie near the middle of the treble stave, or at furthest between G and C; though its low notes, when properly sounded, are very full and mellow. In skilful hands the horn is a most pleasing instrument; but when consigned to the learner, it, as well as the trumpet, is intolerable. Properly speaking, horns are tenor instruments, their tones being an octave below those of the trumpet; we have, however, tenor and bass horns; though the former are rather uncommon: the latter are very powerful, and have a fine effect in military bands. The mouth-piece for this instrument is generally conical; the formation of the notes allowing more freedom, and requiring greater relaxation for all below the key-note than the trumpet, which demands a peculiar constriction of the lips to blow with clearness, and in tune. Formerly the hunting-horn was very large, so that it could be carried like a belt over one shoulder, and under the other; but of late years the practice has been to substitute a small crooked copper horn, which the huntsman fastens to a stirrup leather, or a sling: hence the old hunting music is nearly obsolete, for the small instrument now in use, and which is likewise borne by many of the guards to the mail-coaches, &c. is incapable of sounding many notes: the modern hunting calls are therefore monotonous.

The *Bugle* can scarcely be rated among musical instruments, but being found in military bands, we shall notice it. This instrument had its origin in the common shepherd's horn, i. e. that of an ox; it

sounds only the notes of the common chord with any precision, though sometimes we hear attempts made to diversify its music. It is a very loud instrument, and answers admirably for its usual intentions; namely, assembling the detachments of a corps, communicating signals to rangers, &c. The bugle varies in size, some being a full yard in length, measured along their curve, while others are scarcely a foot in length. The ox-horn is an instrument of very ancient invention; it was originally known among the Hebrews by the name of shawm. The krum horn, now become obsolete, was a small kind of cornet, whose tones were imitated on the organ, by what is generally called the cremona stop. We shall perhaps be correct in tracing all the instruments of the trumpet and horn species to the buccina, of which the antiquity is so remote that its form and intonation have been lost to us. The ancient writers describe it as a crooked horn; we, however, venture to suggest, that the sea-conch was the true buccina, and that horns, properly so called, were used as substitutes where the conchs could not be obtained. The conchs sounded by the Hindoos throughout India, in their religious ceremonies, appear to have been in use from the first institution of that religion, which claims a date far more removed than the time of Adam. The conch is extremely sonorous, throwing its shrill tones often to the distance of a mile or more.

The *Serpent*, so called from its form, seems to be the link that connects the horn with the flute species; its mouth-piece is indeed very similar to that of the trumpet, but it is made of ivory. This is the deepest bass instrument of all that have finger-holes, and which, consequently, have a chromatic compass. But the serpent has some of its lowest notes entirely dependant on the embouchure, or lip play, of the performer. This instrument descends two notes lower than the bassoon, and reaches up to F, on the clef line of the bass, with perfect facility and correctness of intonation. Some performers can, by great practice, advance several notes higher. The serpent is made of very thin wood, covered with buckram and leather, so as to become very firm: hence its tone is by no means smooth, the materials vibrating so very forcibly as to roughen the sounds, especially among the low notes. It has six finger holes, each lined with ivory, ebony, &c. requiring a very firm hand to stop them well. This instrument forms an exact reinforcement to the basses of a military band, to which it is chiefly appropriated.

The *Bassoon*, or *Fagotto*, is the common bass for wind instruments; its compass extends from double B flat up to B flat in the middle of the treble stave. This great range is effected by the aid of a double elastic reed, which fits on to a brass serpentine crook, that gradually becoming thicker enters the top of the instrument. The sound is forced through the instrument in the first instance downwards, but re-ascends through a thicker parallel tube, on which are six holes for the middle fingering: the lower notes are made by a variety of keys and holes, which are managed by both the thumbs, and by the little finger of the right hand. The ample extent of its range gives the bassoon much importance, especially as it is perfectly chromatic throughout; the great similitude of its tone to a good bass voice renders it a most valuable accompaniment; the softness and the fine expression it is capable of producing occasion our best dramatic and lyric composers to avail themselves of its powers, and to allot to it many of the most pleasing passages in overtures, &c. The fingering of the bassoon is, however, extremely difficult; it requires much practice, and a kind of *penchant* for the instrument, to enable the performer to display its full scope, its delicate flute-like intonations, and to give a brilliancy to the wonderful execution of which it admits. It is a great pity that very very few bassoons are perfectly in tune: those made by Barker, Wood, Millhouse, and Cramer, are generally preferred. When the common wooden nozzle, or top, is exchanged for a copper trumpet, or bell mouth, the sounds are much reinforced, and partake something of the intonation of a horn. There have been many varieties of this instrument, the principal of which are as follow: The bombardo, or dulcino, which was formerly used as a bass to the hautboy; the bassoonette, which is an octave higher than the bassoon, but exactly similar; the courtant, or short bassoon, which was made either for right or left handed performers; this appears to have been a very ancient instrument, and probably was the basis of that now in general use. The most curious of this tribe is the cervelet, now but little known, except by description; it was very short, scarcely indeed more than half a foot in length, and was blown with a double reed,

the same as our bassoon, with which it could compare for depth of tone.

The next instrument of this class is the *Vox-humana*, so designated from the great resemblance of its tones to those of the human voice. This is a tenor to the hautboy, and is by many called the tenoroon; it was formerly much used in country churches, and proved a considerable check, keeping the choristers in the right road, and by its great powers concealed a multiplicity of errors among the rustic *marsyases*. Although the vox-humana is remarkably mellow and full-toned, it requires great practice and judgment to produce its notes in perfection. The compass of this instrument is very little more than two octaves; it has two keys, one of which makes the semi-tone above G in either octave, the other making the low F. It is blown with a double reed fixed on a small round conical staple or tube, which fits into the top of the instrument. There are six finger holes, though the third finger of the left hand has sometimes two, very small, instead of one of the ordinary size, for the purpose of making a semi-tone, by covering only one of them; the same as in the Italian hautboy. The bottom of the vox-humana is in form of a bell, and has usually two round holes, one on each side, for the purpose of lessening the vibration, and thus softening the tone. We consider the vox-humana, though exactly similar in every respect, excepting the depth of its notes and its greater bulk, to be far superior to the hautboy, and regret that so very pleasing an instrument should be laid aside, as it has been within the last twenty years. On the other hand, we consider the whole of the reed species of wind instruments to be extremely injurious to the constitution; few who practise them remain long in health, the bassoon and hautboy in particular.

The tones of the latter, *i. e.* the *Hautboy*, or *Oboe*, are by no means so smooth and agreeable as those of the instrument just described; the hautboy has obtained a place among theatrical and other numerous bands, more from the peculiarity of its intonations, and the studied cadences of those who give themselves up entirely to its practice, than from any real merit it possesses. Although we have often been highly gratified by the beautiful passages allotted to the hautboy, and which, being so very exquisitely delivered, commanded our admiration as much of the performer as of the music; yet we could never divest ourselves of the recollection of a bagpipe's nasal intonation; for, setting partiality and fashion aside, we must confess that the soft tones of the flute are better suited to the expression of smooth familiar music; and where more force, and deeper tones are required, we really prefer the clarinet to the hautboy.

We have already stated, that the formation, fingering, &c. of the hautboy exactly resembles those points in the vox-humana, as does also in the reed, that of the former being smaller, proportioned to its size. Its scale reaches from the tenor C to D in alt; including every chromatic, in tolerable perfection, except the low C sharp. Some performers reach to F natural, but we cannot say the sounds, though perfectly in tune, were satisfactory; on the contrary, they added to the nasal effect already noticed, a shrillness, if not a squeaking, which called to our remembrance the answer of Dr. Johnson to a friend who had performed what he termed a cruelly difficult solo on the violin, "Yes, sir, it was a cruel solo, and I wish it had been an impossible one!" The people of Asia have a kind of short hautboy, which has a large swell near its middle; they use a piece of double palm-leaf for a reed. The intonations of this instrument, which are something similar to those of the hautboy, are peculiarly attractive to all the serpent tribe; which often quit their haunts on hearing it, and play round the performers; on this account it is invariably used by the snake-catchers.

The *Clarinet* appears to us, by far, the most noble instrument of this species, it being capable of such mellowness of intonation, such varied expression, and having such a compass: it performs the whole of the chromatic scale from E, below the bass-clef-note, to F in alt; including rather more than three octaves, which exceeds any other wind instrument with which we are acquainted. The clarinet is, with great propriety, considered the principal in our military bands; in these its powerful and rich notes are duly displayed; we must, however, remark, that this instrument is not, generally speaking, calculated for chamber performance; for, with so few exceptions as to be unworthy notice, a certain sibilation is at times very audible, and there is much difficulty in rendering some transitions smooth, so as to avoid a certain kind of staccato distinctness, not unlike an organ badly played: besides, the number of its keys, especially if they are patent, with metal plugs, occasion a rattling that dis-

tracts the attention, and greatly deteriorates the value of the instrument. In the open air, and at a little distance, when these defects cannot obtrude, we think the clarinet, either in a bold martial strain, or in a little *air baderiant*, or in a pathetic, plaintive, movement, stands pre-eminent above all the tribe of inflated instruments; for it admits of the finest swell, and of so much expression that, in many points, it even claims a preference over the organ itself.

Clarinets have, in general, five keys, though some have six and eight holes, of which one, under the instrument, is stopped by the thumb of the left hand, which also commands a key called G sharp, or the chalameau. The little finger of the right hand commands both a hole and a key. The G sharp key covers a very small brass tube, that projects through the wood, about a quarter of an inch, into the thickness of the bore in that part. When the key is uplifted by the thumb, the whole of the notes are raised a twelfth (*i. e.* twelve notes); when it is shut, the tones become deep and rich, and are called chalameau, probably in consequence of the brass tube above described, which originated in a small bit of reed having been inserted there. We are at the same time aware, that all wind instruments are but improvements upon the ancient calamus, or reed pipe, formerly used by shepherds and other rustics. The mouth-piece of the clarinet something resembles that of the common, or English flute, but its groove would be open above for about an inch and a half, were it not covered by a flat single reed, the management of which is by no means very easy. When blown by a novice, the clarinet sounds extremely shrill and harsh, not unlike the most uncomfortable tones proceeding from a goose in distress. The bell of the clarinet is not pierced with lateral holes, as that of the hautboy is; it is spacious, and gives a prodigious resonance to the notes.

For the purpose of accommodating to those keys which are most easy on other instruments, various sizes of clarinets are made; chiefly C and B flat, but sometimes they are made in D; and for the purpose of playing the upper parts of melodies, the principal performers in military bands are provided with some in E flat: there being a minor third above the instruments in C, and a major fourth above those in B flat, raise the music greatly: of course, the parts are transposed accordingly.

The *Flute* is one of our most common instruments, and affords more varieties than any of the foregoing. We shall first treat of the common flute, or flute-a-bec; so called from its embouchure bearing some little resemblance to a beak. It is, by many, supposed to be of English invention, but we cannot admit such to be the case, since it appears to resemble the old calamus, or shepherd's pipe, more than any other of this species. The sound is generated by blowing through a slit into the bore; the superfluous wind passing out at a vent made on the top, close to the upper end; there are seven finger-holes above, and one for each thumb below; some have only one thumb-hole, others two small ones, like the G on a hautboy, for the purpose of making a semitone. All the flageolet tribe, which are of various sorts and sizes, belong to this species. The common flute is also made of various dimensions, thence assuming various designations of second, third, fourth, &c. according as it diminish in size, and becomes shriller in tone. The common flute yields a very soft agreeable sound, and is very appropriate to little artless airs; but, having very little power, is by no means adapted to join in a band. The flageolet is, however, introduced, on many occasions, into dramatic orchestras, and finds a place in some bands; its very piercing notes may be at all times distinguished.

The *German Flute*, or *Traversa*, so called from its being played cross-wise. When this mode of blowing the instrument was first introduced we cannot say, for the generality of medals, statues, &c. of very ancient date exhibit performers on the avena, or common pipe, such as our English flute above described. The auletes, or Grecian flute players, and the Roman tibicines, who performed on double flutes, one fingered by the right, the other by the left hand, thence called dextræ and sinistræ, all played on instruments a bec, and not traversa. The recorder was of the same form; and the still more antiquated monaachos was made of a horn originally, (though afterwards of wood) consequently we are to suppose it also was blown a-bec. The instrument called the zuffolo, or, in French, the sifflet, is but a diminutive flageolet used for teaching birds. We may, from these premises, safely conclude that the German flute is a very modern invention: its name points out the quarter whence it originated.

In lieu of a few simple notes, such as were afforded by the avena, or oaten straw,

and by the calamus, or reed, our flutes have attained to the compass of nearly three octaves, commencing with the tenor C, and reaching up to double B flat in alt, including every chromatic, in various degrees of intonation. Flute-playing is now absolutely a science; and, properly speaking, demands some knowledge of the theory; for to accompany well requires an acquaintance with the intended effect of particular keys, and to form an accompaniment from an arpeggio, or other such passages as a flutist must often do at sight, includes a familiarity with the general rules of counterpoint. We have now flutes with no less than eight keys. From them the various notes are formed, aided by the six holes appropriated to the regular fingering of the instrument, as originally invented; viz. with only one key, appropriated to the little finger of the right hand. We have flutes with extra joints, patent slides, patent metallic plugs, &c.; yet, strange to say, it is absolutely a very rare thing to hear a flute in perfect tune. The fault, however, not unfrequently lies with the performer, who should possess an excellent ear: for, though the notes are supposed to be ready made, according to the directed fingerings, yet so much depends on his embouchure and his manner of blowing, that there remains almost as much for him as for the violin player, towards producing truly correct intonations. The sweet mellow tone of the German-flute adapts it admirably to those passages requiring tender expression; its swell renders it capable of yielding an efficient and a graceful holding note; while the warbling of its shake seems to rival the feathered songster. We regret often to hear these qualities most egregiously misapplied, and, indeed, neglected, to make way for a very uncharacteristic frittering of the notes, in hurried succession, and in a very absurd style: the promiscuous applause of a wondering audience is frequently bestowed on a performer, whose quibbles on this instrument should rather be discountenanced. What the flute can do should be reserved for solos on that instrument.

The several kinds of flutes are distinguished according to the number of keys, to their purposes, and to their sizes; they are generally called seconds, thirds, &c. as they recede from the standard, diminishing gradually, according to the above terms. The smallest flutes are called piccolo, which implies diminutive: this kind may be sometimes heard in military bands, in which it is often introduced with effect, but we have heard it too much employed by the composer.

The *Fife* is a well known instrument, almost exclusively allotted to military purposes. Its scale is rather less copious than that of the flute; and for want of keys, though of late years one has been added to some fifes, the chromatic progressions are extremely imperfect.

The *Pipe* is very little known, except as a shrill accompaniment to the tabor, and in pastoral dances. Some pipes have two, others three holes above, and one for the thumb below; all managed by the left hand, the right using the stick for the tabor, which is suspended from the wrist of the left hand.

The *Bagpipe* is of two sorts; viz. the Scots and the Irish: the former is filled by means of a wind-bag, carried under the arm, and worked like a pair of bellows; the other plays with a reed, like the hautboy. These two species have, within these few years, been blended, under the designation of the union-pipes; both are fingered much the same as a flute, and have a drone, or open tube, through which the wind passes, causing a deep humming tone. The bagpipe, however ancient many assert it to be, nevertheless appears to be derived from the old Gallic musette (which it in every instance resembles); as the musette was from the ancient Hebrew sampunia. Happily all this genus are rapidly declining.

Having noticed the whole, if we err not, of the instruments in the second class, *i.e.* of inflation, we shall close their description with observing, that in the organ building line the names of Lincoln and England have long been pre-eminent; and that, in the manufacture of flutes, Mr. Potter has been justly celebrated. On the whole, however, we have great reason to believe that the wind instruments made by Messrs. Wood, Goulding, and Co. of New Bond-street, will be found excellent of their kind: the great extent of their sales, in that branch, evinces the satisfaction they give, and which a very expensive establishment, of the best artificers, seems likely to uphold.

The class of collision seems to appertain exclusively to those instruments which are provided with strings, or wires, and are played upon by means of a piece of curved wood, subtending a quantity of horse hair, regularly disposed in a flat and parallel manner: these we call bows; they are of various sizes, according to the instruments

to which they respectively are applied; namely, the double bass, the violincello, the tenor, the violin, and the kit.

The form of the *Double-Bass* is well known; its tones are a whole octave below those of the violincello, and its scale is equally perfect. It sometimes has a part composed expressly for it, under the term violono; in which case it performs only the most accented parts of the bass, bordering, indeed, on the fundamental progressions: in most instances, we see it playing in unison with the violincello. The double-bass certainly is very emphatic, and has a rich effect in such passages as require to be strongly marked.

The *Violincello* is an instrument perfectly indispensable in all orchestras, and at regular musical meetings; its scale is extensive, being down to double C, and reaching as high as A, or B flat, in the middle of the treble stave. Its tones are very fine; and, in the hands of a solo performer, the violincello displays a brilliancy far beyond what its appearance would lead us to expect.

The *Tenor*, *Alto*, *Taille*, or *Quinte*, is a large-sized violin, one octave above the violincello, and, like it, has two catgut and two covered strings: this instrument sustains the medium parts between the treble and the bass, connecting the harmony, and filling that great interval which would else be inevitably left void on many occasions. We think the tenor possesses a most mellow and expressive tone: when supporting a full passage, it proves a fine prop to the trebles; and when leading the melody, and sustained by the violincello, affords, in general, a rich treat to musical amateurs. Its effect is best heard in Pleyel's Quartets, &c.

The *Violin* may be considered as the chief of this tribe: it will be unnecessary to describe its form, &c. the instrument being so universally known: its scale extends from G, above the bass clef, up to double D, in alt; beyond which, though notes may be made, the tone becomes rather offensively shrill; and, generally speaking, borders on a kind of whistling scream. The pre-eminent expression, and the wonderful execution which may be effected with the violin, added to the great compass we have above stated, (it being full three octaves and a half) justly occasion this incomparable instrument to take the lead in concerts and orchestras; and, in general, in all musical meetings. It is to be lamented, however, that we cannot boast of so complete an intimacy with the construction of the violin, and of all its class, as Italy and some other parts of the Continent. We have some tolerable makers; but the names of Amati, Staduarius, &c. no sooner appear, than the names of inferior workmen seem to shrink from notice. It really is surprising, but strictly true, that immense quantities of violins, tenors, &c. &c. are regularly imported from the Continent, as a wholesale trade, and at so low a rate as five, six, or seven shillings each; from these our inferior performers are chiefly supplied. Hence it must be obvious, that our artizans in this line suffer under a very injudicious toleration, which, in any other branch of business, would be speedily complained of, and the importation be restricted to the raw material. Possibly the legislature may, at some leisure moment, turn its attention to this subject.

The *Kit*, or pocket-violin, is a small instrument intended for the use of dancing-masters, &c.; it differs in no respect from the above description, except in the poorness of its tones, which are by no means pleasant: owing to the want of space, for placing the fingers, it is extremely difficult to perform well on the kit.

We scarcely know with what to class the *Humstrum*, which consists of a large lath made into a bow, by means of a very thick piece of catgut, such as the string of a double bass: on this string a bladder is affixed. The humstrum is played with a bow, rubbed with rosin, the same as for the violin, &c. and the notes, which, however, are few in number, are made by shifting the fingers, or occasionally the bladder: we believe this instrument is used only among the vulgar, and that it is very nearly obsolete.

All the violin class have four strings, fastened at one end to a small piece of ebony, called the tail-piece; and, after passing over a raised bridge, made of seasoned beech-wood, (particularly the back of old instruments) and over a little ridge, called the nut, are fastened respectively to four pegs, made of very hard tough wood, by the turning of which they are put in tune: all the strings give fifths to their neighbours throughout: thus the first string is E, the second is A, the third is D, and the fourth, which is a covered one, is G. The tenors and basses have no E string; but a C one, added below the G. The notes are made by compressing, *i. e.* by what is called stopping, the strings on a rounded slip of ebony, called the finger-board, which proceeds from the nut, full four-fifths of the distance between that and the bridge; the lat-

ter being always placed on the belly, or sounding-board, exactly between the centres of two sound-holes, which are in the form of an S: the belly is supported by a small piece of rounded deal, called the sounding-post, without which the tones would be imperfect and harsh. The invention of sounding-boards appears to have been taken from the echeia, or vases, placed among the audium, and especially near the performers, in the ancient theatres, for the purpose of resonance. See ORCHESTRA.

The whole of those instruments, which are retained in modern use, are occasionally to be found collected in an orchestra; but for a military band, such only can be adapted as are portable, and are not subject to lose, or to change their intonations, or to be injured in the open air, or whose casualties could not be immediately made good. Hence all stringed instruments are unfit for the latter purpose.

MUSICIAN, is defined, by Dr. Busby, as one who understands the science of music, or who sings, or performs some instrument according to the rules of art. There are three kinds of musicians; the speculative musician, or musical author, properly so called, who contemplates and writes on the laws of sound and harmony; the practical theorist, or composer, who produces music written agreeably to those laws; and the performer, who, with his voice or instrument, executes the music when written.

MUSK, a substance secreted into a kind of bag in the umbilical region of the moschus moschifer. It is of a brown red colour, feels unctuous, and has a bitter taste. Its smell is aromatic and intensely strong. It is partially soluble in water, which acquires its smell; and in alcohol, but that liquid does not retain the odour of the musk. Musk is dissolved by nitric and sulphuric acids, but the odour is by them destroyed. Fixed alkalies develope the odour of ammonia.

MUSKET, a fire-arm borne on the shoulder, and used in war. The length of a musket is fixed at three feet eight inches from the muzzle to the pan, and it carries a ball of sixteen to the pound.

In fortification, the length of the line of defence is limited by the ordinary distance of a musket shot, which is about 120 fathoms; and the length of almost all military architecture is regulated by this rule.

MUSKETOON, a kind of short thick musket, whose bore is the thirty-eighth part of its length; it carries five ounces of iron, or seven and a half of lead, with an equal quantity of powder. This is the shortest sort of blunderbusses.

MUSLIN, a fine thin sort of cotton-cloth, which bears a downy knap on its surface. There are several sorts of muslins brought from the East Indies, and more particularly from Bengal; such as doreas, betelles, mulmuls, tanjeebs, &c.

MUSSÆNDA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Rubiaceæ, Jussieu. Essential character: corolla funnel form; stigmas two, thickish; berry oblong, inferior; seeds disposed in four rows. There are three species, natives of the East Indies, China, and Cochin China.

MUSSEL. See MYTILUS.

MUSTER, in a military sense, a review of troops under arms, to see if they be complete, and in good order; to take an account of their numbers, the condition they are in, viewing their arms and accoutrements, &c. At a muster every man must be properly clothed and accoutred, &c. and answer to his name.

MUSTER *roll*, a specific list of the officers and men in every regiment, troop, or company, which is delivered to the inspecting field officer, muster-master, regimental or district paymaster (as the case may be) whereby they are paid, and their condition is known. The names of the officers are inscribed according to rank, those of the men in alphabetical succession. Adjutants of regiments make out the muster rolls, and when the list is called over, every individual must answer to his name. Every muster-roll must be signed by the colonel or commanding officer, the paymaster and adjutant of each regiment, troop, or company; it must likewise be sworn to by the muster-master or paymaster (as the case may be) before a justice of the peace, previous to its being transmitted to government.

MUTE, in case any person refuses to plead to an indictment for felony, &c. he is now by stat. 12 Geo. III. c. 20, to be considered as pleading guilty, and to be punished as upon confession. Formerly a plea was extorted from him by a process, which was called the *peine forte et dure*, and which has been justly considered as inhuman and disgusting. In a late trial, the case of Governor Picton, who was prosecuted for putting a young girl to torture, to extort

evidence in the West Indies; this *peine forte et dure* has been called torture, but this is a gross perversion of language to justify cruelty and barbarity. The former ceased the moment the person put himself on his country, that is, on a jury for trial, by the formally pronouncing the words not guilty. The latter is continued and increased the more the sufferer asserts his innocence, and is instituted for the purpose of extorting by cruelty, a confession of guilt, whether true or false. Perish the wretch who in thought even endures the revival of the most odious of all human crimes, the application of torture.

A prisoner deaf and dumb from his birth, may be arraigned for a capital offence, if intelligence can be conveyed to him by signs or symbols.

Mute, in grammar, a letter which yields no sound without the addition of a vowel. The simple consonants are ordinarily distinguished into mutes and liquids, or semivowels.

The mutes in the Greek alphabet are nine, three of which, *viz.* π, κ, τ, are termed tenues; three, β, γ, δ, termed mediæ; and three, φ, χ, θ, termed aspirates. The mutes of the Latin alphabet are also nine, *viz.* B, C, D, G, I, K, P, Q, T.

MUTINY, in a military sense, to mutiny is to rise against authority. Any officer or soldier who shall presume to use traitorous or disrespectful words against the sacred person of his Majesty, or any of the Royal Family, is guilty of mutiny. Any officer or soldier who shall behave himself with contempt or disrespect towards the general, or other commander in chief of our forces, or shall speak words tending to their hurt or dishonour, is guilty of mutiny. Any officer or soldier who shall begin, excite, cause, or join in any mutiny or sedition, in the troop, company, or regiment, to which he belongs, or in any other troop, or company, in our service, or on any party, post, detachment, or guard, on any pretence whatsoever, is guilty of mutiny. Any officer or soldier who, being present at any mutiny or sedition, does not use his utmost endeavours to suppress the same, or coming to the knowledge of any mutiny, or intended mutiny, does not, without delay, give information to his commanding officer, is guilty of mutiny. Any officer or soldier, who shall strike his superior officer, or draw, or offer to draw, or shall lift up any weapon, or offer any violence against him, being in the execution of his office, on any pretence whatsoever, or shall disobey any lawful command of his superior officer, is guilty of mutiny. See the Articles of War.

MUTISIA, in botany, so named in memory of Joseph Cælestine Mutis, an American botanist, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx cylindric, imbricate; corollets of the ray oval oblong; of the disk trifid; down feathered; receptacle naked. There is but one species, viz. M. clematis, found in New Granada.

MUTULE, in architecture, a kind of square modillion, set under the corniche of the Doric order. The only difference between the mutule and modillion consists in t[illegible] that the former is used in speaking of th[illegible] oric order, and the latter in the Cori[illegible] in.

[illegible] A, in natural history, a genus of inse[illegible] of the Vermes Testacea class and orde[illegible] Animal ascidia; shell bivalve, genera[illegible] gaping at one end; hinge with broad th[illegible] strong teeth, seldom more than one, [illegible] ot inserted into the opposite valve. [illegible] nimals of this genus perforate into [illegible] nd and clay at the bottom of the sea, [illegible] g themselves and their shells wholly o[illegible] part. There are about twenty-five s[illegible] s. M. declivis has a brittle, semi[illegible] arent shell, sloping downwards near [illegible] pen end; the hinge slightly prominent[illegible] It is found about the Hebrides, and the f[illegible] h is in great esteem among the inhabitants. M. margaritifera inhabits most parts of the arctic circle, and is generally found in mountainous rivers, and about cataracts. It is about five inches long, and half as many broad. The shell is often corroded with worms; it is noted for producing large quantities of mother of pearl and pearl, the latter is said to be a disease of the fish analogous to the stone in the human body. The river Conway in Wales, was formerly famous for producing pearl of great size and value. M. dubia, shell with an oval and large hiatus opposite the hinge, and the rudiment of a tooth within one valve. It is found near Weymouth; the shell is brittle, about the length of a horse-bean, and shaped like a pistachia-nut.

MYAGRUM, in botany, *gold of pleasure*, a genus of the Tetradynamia Siliculosa class and order. Natural order of Siliquosæ, or Cruciformes. Cruciferæ, Jussieu. Essential character: silicle terminated by a conical style, with a cell commonly one-seeded. There are ten species, of which M. perenne,

perennial gold of pleasure, Mr. Miller describes this as an annual plant, notwithstanding he gives it Linnæus's epithet of perenne; the lower leaves are large, jagged, and hairy; the stalks branching out from the bottom; leaves about four inches long, and two broad; the stalks terminated by very long loose spikes of yellow flowers, succeeded by short pods with two joints, each including one roundish seed. Linnæus remarks, that the lower joint of the silicle is strict and abortive; the upper globular, striated, one-seeded. Native of Germany.

MYCTERIA, the *jabiru*, in natural history, a genus of birds of the order Grallæ. Generic character: bill long and large, both mandibles bending upwards, the upper triangular; nostrils small and linear, and no tongue; feet four-toed and cleft. M. Americana, or the American jabiru, is nearly six feet in length, and makes a nearer approach than any other bird to the size of the ostrich. It abounds in the level districts of Cayenne, and other parts of South America, feeds upon fish, of which it devours immense quantities, and builds in vast trees, laying only two eggs. It is extremely wild, when young is used for food, but when old is hard and rancid. Many have supposed this to be the American ostrich of various authors, and Latham expresses himself rather confidently as of the same opinion.

MYGINDA, in botany, so named in honour of the most noble Francis a Mygind, Aulic Counsellor, well skilled in botany, and protector of the botanic garden at Vienna, a genus of the Tetrandria Tetragynia class and order. Natural order of Rhamni, Jussieu. Essential character: calyx four parted; petals four; drupe globular. There are three species, natives of the West Indies.

MYOPES. Those who by a natural defect have the cornea and crystalline humour too convex, are called myopes. This figure, which increases the quantity of refraction, tends to render the rays of such pencils as are formed in the eye more convergent, so that the point where these same rays meet is on this side of the retina. Myopes see distinctly those objects only which are near, which send towards the eye rays more divergent, and thereby less disposed to converge, through the effect of refraction in the crystalline and other humours. This imperfection being the reverse of that which affects the eye of presbytæ, is remedied by the use of a glass slightly concave; which, increasing the divergence of the rays received by the eye, prolongs the pencils that are formed in the organ, and causes their summits to fall more exactly on the retina. Myopes seem to have a fondness for minute objects; in general they write a very fine hand, and read in preference works that are printed in a small type, because by choosing dimensions suited to the narrow scope of their sight, they continue to embrace a greater number of objects at once. They have the habit also of closing, in a certain degree, the eyelids, when they wish to see objects distinctly that are otherwise distant for them. Two advantages have been ascribed to this natural motion. On the one hand, by contracting the lid, access is given to a smaller portion of light. Now those who are myopes see objects that are situated at a distance indistinctly, merely because the cones that are formed in the eye, as we have observed in the preceding paragraph, have their summit on this side the retina; so that the prolongations of the rays of which these cones are the assemblage, give rise to new cones, whose base meeting the bottom of the eye depicts a small circle there, instead of a simple point. Accordingly, when the number of rays introduced into the eye is diminished, that small circle is contracted, and the vision becomes less confused. On the other hand, the eye-lids, by closing, exert a pressure on the organ that diminishes its convexity, and in part restores it to the form most favourable to clearness of vision.

MYOPORUM, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Essential character: calyx five-parted; corolla bell-shaped, with a spreading almost equal five-parted border; berry one or two-seeded; seeds two-celled. There are four species; these plants are natives of the islands of the South Sea.

MYOSOTIS, in botany, *scorpion-grass*, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Boragineæ, Jussieu. Essential character: corolla salver-shaped, five-cleft, emarginate; the opening closed with arches. There are seven species, of which M. scorpioides, mouse-ear scorpion-grass, has an annual fibrous root; stems several, procumbent, erect; leaves alternate, entire, bent back a little at the edge; the lower leaves are elliptic or oblong, the middle and upper ones are lanceolate, from an inch and half to two inches in length; flowers in ra-

cemes, when young, bending in at the top, whence the names of scorpioides, scorpiurus, and scorpion-grass, from the similitude to a scorpion's tail; as the flowering advances, lengthening out very considerably; they are alternate, in a double row, all growing one way, each on its proper pedicel; calyx villose, deeply five-cleft, closing at top as the seeds ripen; corolla red before it opens, afterwards of a fine blue, with a yellow eye, not more than a tenth of an inch in diameter.

MYOSURUS, in botany, *mouse-tail*, a genus of the Pentandria Polygynia class and order. Natural order of Multisiliquæ. Ranunculaceæ, Jussieu. Essential character: calyx five-leaved, growing together at the base; petals five, having a melliferous pore at the claw; seeds numerous. There is but one species, *viz.* M. minimus, mouse-tail: this plant is very nearly allied to ranunculus, in which genus it was ranged by Tournefort; the flowers are extremely small, and are succeeded by long, slender spikes of seeds, resembling the tail of a mouse, whence the name; it grows wild in most parts of Europe. This plant affords a rare instance of a very great disproportion of males to females in the same flower, and yet the latter are generally all prolific; the seeds are justly described by Linnæus as naked, for the part which Jussieu calls a capsule is nothing more than a thickened inseparable coat, as in ranunculus.

MYOXUS, the *dormouse*, in natural history, a genus of Mammalia of the order Glires. Generic character: two fore-teeth, the upper wedge formed, the lower compressed; four grinders in each jaw; long whiskers; tail cylindric, bristly, and thicker towards the end; legs of equal length; fore-feet with four-toes. These animals feed only on vegetables, and burrow in the ground, in which they continue during the winter in a torpid state. They are nocturnal, sleeping in their habitations the greater part of the day; they carry food to their mouths with their fore-paws, sitting erect, and advance by leaps of several feet at a time, instead of walking. There are four species, M. glis, or the fat dormouse, is found in Germany and Russia, and has much of the manners of a squirrel, haunting trees and feeding on fruits and nuts which it stores, like that animal, for its winter consumption. It was highly valued by the Romans as an article of food. It is six inches long to the tail, which is about four. It is not easily tamed.

M. muscardinus, or the common dormouse, is nearly of the size of a mouse, and inhabits thick hedges, making its nest in the hollow of some tree. It is far from lively, and is incapable of bounding like the squirrel. Like that animal, however, it forms its hoard for the winter, during which it is for the greater part abstinent and torpid. It occasionally is roused by the intervention of temperate days, recurs to its stock, and then returns to its slumbers, till spring recovers it to daily exertion. It is very rarely seen in this country, but is supposed to be in fact by no means uncommon. For the garden dormouse and the wood dormouse, see Mammalia, Plate XVII. fig. 1 and 2.

MYRICA, in botany, *candleberry myrtle*, a genus of the Dioecia Tetrandria class and order. Natural order of Amentaceæ, Jussieu. Essential character: ament with a crescent-shaped scale; corolla none: female, styles two; berry one-seeded. There are nine species, of which M. gale, sweet-gale, sweet willow or candleberry myrtle, rises with many shrubby stalks from two to four feet in height, dividing into several slender branches; the buds are composed of [illegible] leafy, shining scales; leaves alternate, an inch and half in length; they have a bitter taste, and an agreeable odour, like those of myrtle. The flowers appear before the leaves, at the ends of the branches; as soon as the fructification is completed, the end of the branch dies, the leaf-buds which are on the sides, shoot out, and the stems become compound; the fruit is a coriaceous berry; the male and female aments are sometimes on distinct plants, and sometimes on the same individual. The northern nations formerly used this plant instead of hops, and it is still in use for that purpose in some of the western isles; unless it is boiled a long time, it is reported to occasion the head-ach. The catkins, or cones, boiled in water, throw up a scum resembling bees' wax, and which, gathered in sufficient quantities, would make candles. From M. cerifera, American candleberry myrtle, candles are prepared in America; it is also used in tanning calf skins; gathered in autumn, it will dye wool yellow, for which purpose it is used both in Sweden and in Wales; the Welsh lay branches of it upon and under their beds, to keep off fleas and moths. In most of the Hebrides, and in the Highlands of Scotland, an infusion of the leaves is frequently given to children to destroy worms. When it grows

within reach of a port, the sailors make besoms of it for sweeping their ships. Native of the northern parts of Europe and North America.

MYRIOPHYLLUM, in botany, a genus of the Monoecia Polyandria class and order. Natural order of Inundatæ. Naiades, Jussieu. Essential character: calyx four-leaved; corolla none: male, stamina eight: female, pistils four; style none; seeds four, naked. There are two species, viz. M. spicatum, spiked water milfoil, and M. verticillatum, whorled water milfoil. These are perennial herbs, inhabitants of the water; leaves in whorls, pinnate, linear; flowers axillary, sessile, solitary, in the upper whorls male, in the lower female; in the second species they are frequently hermaphrodite.

MYRISTICA, in botany, *nutmeg-tree*, a genus of the Dioecia Syngenesia class and order. Natural order of Lauri, Jussieu. Essential character: calyx trifid; corolla none: male, filament columnar; anthers terminating, united: female, capsule superior, drupaceous, two-valved; nut involved in an aril, called the mace. There are three species, of which M. aromatica, aromatic or true nutmeg-tree, grows to a considerable size in the East Indies, with erect branches, and a smooth ash-coloured bark; the inner bark is red; leaves petioled, alternate, quite entire, shining, paler underneath, nerved; peduncles axillary, two or three-flowered, solitary; only one flower arrives at maturity; calyx fleshy, smooth; segments spreading, shorter than the tube; filament solid, the length of the calyx; anthers eight, ten, or twelve, growing longitudinally round the upper half of the filament; calyx in the female smaller; covering of the fruit or mace subdivided irregularly like a net, fulvous. The leaves are aromatic; and if the trunk or branches be wounded, they will yield a glutinous red liquor.

MYRMECIA, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Gentianæ, Jussieu. Essential character: calyx tubular; five-toothed; corolla one-petalled, with an inflated mouth and five-cleft border; germ with five glands at the base; stigma bilamellate; capsule two-celled, two-valved, many-seeded. There is but one species, viz. M. tachia, which is a shrub five or six feet in height; thick at the base, gradually diminishing as it ascends, throwing out a few long, rough, four-cornered branches, which are opposite and tubular; at each knot of these branches grow two opposite leaves, disposed crossways; from the bosom of one of these leaves proceeds a sessile flower, of a yellow colour; and it generally happens, that at the bosoms of those leaves which do not produce flowers, a tear of yellow resin makes its appearance. The hollow trunk and branches of this shrub are commonly the retreat of a great many ants, for which reason it is called by the natives of Guiana, tachi, which is said to signify an ant's nest.

MYRMECOPHAGA, the *ant-eater*, in natural history, a genus of Mammalia, of the order Bruta. Generic character: no teeth; tongue extensile and cylindric; mouth elongated into a form somewhat tubular; body covered with hair. Though these animals are stated above to have no teeth, dissection shows that they have certain bony substances, not very different from them, fixed firmly at the lower end of their jaws. They subsist on insects, and particularly that species of them from which they are designated. Thrusting their tongue into a nest of ants, the glutinous substance which exudes from it, serves to attach to it inextricably numbers of these insects, and when the animal perceives, by the exquisite feeling of the papillæ, that he has secured a sufficient number, he withdraws his tongue by an instantaneous movement, and swallows his victims. There are seven species. The following are principally deserving of attention.

M. jubata, or the great ant-eater, is an animal of a very inelegant and rough appearance, and more than seven feet in length. It is a native of South America, slow in its movements, and heavy in its manners, sleeping during almost the whole day; the night it passes principally in search of food. With its fore claws it can destroy by pressure and laceration animals apparently much stronger than itself. In a state of confinement it has devoured four pounds of animal food in a day.

M. tetradactyla, or the middle ant-eater, is far inferior in size, being little more than two feet in its whole length. It is a native of the same regions, and is similar in its habits. It possesses, however, a prehensile power with its tail, and in climbing trees, and, moving from branch to branch, is much assisted by this circumstance.

M. didactyla, or the little ant-eater, is about as large as a squirrel, covered with a soft and curled fur of yellow brown, and possesses considerable elegance. Its tail is prehensile; it resides in trees, and subsists,

like the former species, principally on insects, and particularly ants. It is a native of Guiana. Animals of a similar description are found both in Africa and the Indian islands. In the former, they are stated to attain the weight of a hundred pounds, and to have such a tenaciousness of gripe, that the efforts of the strongest man cannot unfix their claws when fully stuck in the ground.

M. aculeata, or the aculeated ant-eater, is a native of New Holland, and appears to connect the ant-eater genus with the porcupine. It has the spines of the latter, and the mouth, tongue, and habits of the former. It is generally found in the middle of an ant's nest, and will burrow with extreme celelerity. It will even tear up a pavement of some firmness. It is little more than a foot long. For a representation of the ant-eater, see Mammalia, Plate XVII. fig. 3.

MYRMELEON, in natural history, *lion-ant*, a genus of insects of the order Neuroptera. Mouth with a horny, acute mandible and jaw; feelers six, antennæ thicker at the tip; wings deflected; tail of the male armed with a forceps, composed of two straight filaments. There are sixteen species of this genus enumerated by Gmelin, which are divided into two sections, *viz.* A. Hind-feelers much longer; jaw one toothed; lip membranaceous, square, truncate, emarginate. B. Feelers nearly equal; jaw ciliate; lip horny, rounded, entire. The animals of this family prey with the most savage ferocity on ants and lesser insects, and for the purpose of ensnaring them, sinks itself into the sand, and forms a kind of funnel or pit in which it lies buried, the head only appearing above the sand. Into this hollow such insects as wander near it are sure to fall, and not being able to crawl up the sides of loose sand, are seized and devoured by the lion ant. But if the sides of the pit do not give way, or the unlucky insect appears to be able to make its escape, its merciless enemy, by throwing with its head repeated showers of sand, forces it down till it comes within its reach. The larva is six-footed, with exserted, toothed jaws; pupa enclosed in a ball composed of sand or earth, agglutinated and connected by very fine silk, which it draws from a tubular process at the extremity of the body: with this silk it also lines the internal surface of the ball, which, if opened, appears coated by a fine pearl-coloured silken tissue. It continues in the state of chrysalis about four weeks, and then gives birth to the complete insect. M. formicaleo, in its complete or fly-state, bears a great resemblance to a small dragon-fly, from which it may be distinguished by its antennæ. It is not found in this country, but occurs in many parts of the Continent. See Plate III. Entomology, fig. 5.

MYRODENDRUM, in botany, a genus of the Polyandria Monogynia class and order. Essential character: corolla five petalled, spreading, much larger than the five-toothed calyx; stigma capitate, five-lobed; pericarpium five celled, with one seed in each cell. There is but one species, *viz.* M. balsamiferum: this is a tree from fifty to sixty feet in height, and two in diameter; it throws out from the top several large branches, which divide into branchlets beset with alternate, smooth, green, long leaves, terminating in a point; these leaves are largest at their base, where they partly embrace the branchlets; the flowers are borne in heads or clusters, from the leaves at the extremities of the branchlets, of a white colour. The bark of this tree affords a red balsamic fluid, resembling styrax in scent; this liquor, after it has exuded from the bark, becomes hard, brittle, and transparent, and when burnt, affords a very agreeable odour. The Negroes use the bark for the purpose of slips, to make flambeaux, and the natives for building their houses. It grows naturally in the forests of Guiana.

MYRODIA, in botany, a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx single, one leafed; corolla five-petalled; pistil one, column of anthers undivided; drupe dry, inclosing two nuts. There are two species, *viz.* M. turbinata, and M. longiflora; the former is a native of the West Indies, and the latter of Guiana, growing on the banks of rivers.

MYROSMA, in botany, a genus of the Monandria Monogynia class and order. Natural order of Scitamineæ. Cannæ, Jussieu. Essential character: calyx double, outer three-leaved, inner three-parted, corolla five parted, irregular; capsule three-cornered, three-celled, many seeded. There is but one species, *viz.* M. cannæformis, a native of Surinam.

MYROXYLUM, in botany, *sweet-wood*, a genus of the Decandria Monogynia class and order. Natural order of Lomentaceæ. Leguminosæ, Jussieu. Essential character: calyx bell-shaped; petals five, the upper-

most larger; germ longer than the corolla; legume one-seeded. There is but one species, viz. M. peruiferum; this is a very beautiful tree, with a smooth, thick bark, which is resinous; leaves alternate, leaflets in two pairs, mostly opposite, they are entire, veined, and very smooth; racemes axillary, erect, pointing one way, peduncle roundish, pubescent, flowers scattered; pedicels erect; calyx hoary green, on the outside of the orifice surrounded by the petals and anthers, which are white, within containing the green legume, having a singular appearance; the substance of the leaves is full of linear dots, they are transparent and resinous. The balsam of Peru is the produce of this tree; it is a native of the hottest provinces of South America.

MYRSINE, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Bicornes. Sapotæ, Jussieu. Essential character: corolla half five-cleft, converging; germ filling the corolla; berry one-seeded, with a five-celled nucleus. There are two species, viz. M. Africana, African myrsine, and M. retusa, round-leaved myrsine, or tamaja.

MYRTUS, in botany, *myrtle*, a genus of the Icosandria Monogynia class and order. Natural order of Hesperideæ. Myrti, Jussieu. Essential character: calyx five-cleft, superior; petals five; berry two or three-celled; seeds several, gibbous. There are thirty-six species and many varieties. This genus is composed of small trees and shrubs; flowers in some solitary, with two scales at the base; in others forming opposite corymbs or panicles, axillary or terminating. The M. communis, common myrtle, is well known, and admired as an elegant evergreen shrub: it is a native of Asia, Africa, and the southern parts of Europe; it was a great favourite amongst the ancients, for its elegance, and its evergreen sweet leaves; it was sacred to Venus, either on this account, or because it flourishes most in the neighbourhood of the sea. Myrtle wreaths adorned the brows of bloodless victors, and were the symbol of authority for magistrates at Athens; both branches and berries were put into wine, and the latter were used in the cookery of the ancients: the myrtle was also one of their medicinal plants; it is an astringent, but is now discarded from modern practice.

MYTHOLOGY, the history of the fabulous gods and heroes of antiquity, with the explanations of the mysteries or allegories couched therein. Lord Bacon thinks, that a great deal of concealed instruction and allegory was originally intended in most part of the ancient mythology: he observes, that some fables discover a great and evident similitude, relation, and connection, with the thing they signify, as well in the structure of the fable, as in the meaning of the names, whereby the persons or actors are characterised.

The same writer thinks it may pass for a further indication of a concealed and secret meaning, that some of these fables are so absurd and idle in their narration, as to shew an allegory even afar off: but the argument of most weight upon this subject he takes to be this, that many of these fables appear by no means to have been invented by the persons who relate them: he looks on them not as the product of the age, nor invention of the poets, but as sacred relics, as he terms them, gentle whispers, and the breath of better times, that from the tradition of more ancient nations came at length into the flutes and trumpets of the Greeks. He concludes, that the knowledge of the early ages was either great or happy: great if they by design made this use of trope and figure; or happy, if, whilst they had other views, they afforded matter and occasion to such noble contemplations.

MYTILLUS, in natural history, the *mussel*, a genus of insects of the Vermes Testacea class and order. Animal allied to an ascida; shell bivalve, rough, generally affixed by a byssus, or beard of silken filaments; hinge mostly without teeth, with generally a subulate, excavated, longitudinal line. There are between fifty and sixty species, divided into sections, viz. A. parasitical, affixed as it were by claws; B. flat, or compressed into a flattened form, and slightly eared; C. ventricose, or convex. In the second division is M. margaritiferus, which inhabits the American and Indian Seas; about eight inches long, and something broader; the inside is beautifully polished, and produces true mother-of-pearl, and frequently the most valuable pearls; the outside sometimes sea-green, or chesnut, or bloom colour, with whitish rays; when the outer coat is removed it has the same perlaceous lustre as the inside; the younger shells have ears as long as the shell, and resemble scallops. M. edulis inhabits European and Indian Seas, found in large beds, adhering to other bodies by means of a long silky beard: the fish affords a rich food, but is often noxious to the constitution.

corolla none; pistil one; capsule e-celled. There is but one species, arina, which, according to Jussieu, e whorled sheathing leaves, the axillary, sessile; the filament in the owers long, with a four-valved an- hich is the four-cleft corolla of Lin- in the female flowers two stigmas, ne nut, or four seeds. Native of the coast of Europe; in the canal between and Leghorn; and in the Rhine, near le.

NAIL. See ANATOMY.

The nails have been chemically examin- d, and are found to be composed chiefly of membranous substance, which possesses the properties of coagulated albumen. They contain also a little phosphate of lime. Water softens but does not dissolve them. They are readily dissolved and decomposed by concentrated acids and alkalies. It is pretty certain that they are composed of the same substances as HORN, which see. Under the head of nails must be comprehended the talons and claws of the inferior animals, and likewise their hoofs, which differ in no respect from horn.

NAILS, in building, &c. small spikes of iron, brass, &c. which being driven into wood, serve to bind several pieces together, or to fasten something upon them. The several sorts of nails are very numerous: as 1. Back and bottom nails; which are made with flat shanks to hold fast, and not open the wood. 2. Clamp-nails, for fastening the clamps in buildings, &c. 3. Clasp-nails, whose heads clasping and sticking into the wood, render the work smooth, so as to admit a plane over it. 4. Clench-nails, used by boat and barge builders, and proper for any boarded buildings that are to be taken down, because they will drive without splitting the wood, and draw without breaking; of these there are many sorts. 5. Clout-nails, used for nailing on clouts to axle-trees. 6. Deck-nails, for fastening of decks in ships, doubling of shipping, and floors laid with planks. 7. Dog-nails, for fastening hinges on doors, &c. 8. Flat-points, much used in shipping, and are proper where there is occasion to draw and hold fast, and no conveniency of clenching. 9. Jobent-nails, for nailing thin plates of iron to wood, as small hinges on cupboard-doors, &c. 10. Lead-nails, for nailing lead, leather, and canvass, tohard wood. 11. Port-nails, for nailing hinges to the ports of ships. 12. Pound-nails, which are four-square, and are much used in Essex, Norfolk, and Suffolk, and scarcely any where else, except for pailing. 13. Ribbing-nails, principally used in ship building, for fastening the ribs of ships in their places. 14. Rose-nails, which are drawn four-square in the shank, and commonly in a round tool, as all common two-penny nails are; in some countries all the larger sort of nails are made of this shape. 15. Rother-nails, which have a full head, and are chiefly used in fastening rother-irons to ships. 16. Round head nails, for fastening on hinges, or for any other use where a neat head is required; these are of several sorts. 17. Scupper nails, which have a broad head, and are used for fastening leather and canvass to wood. 18. Sharp-nails, these have sharp points and flat shanks, and are much used, especially in the West Indies, for nailing soft wood. 19. Sheathing-nails, for fastening sheathing-boards to ships. 20. Square-nails, which are used for hard wood, and nailing up wall-fruit. 21. Tacks, the smallest of which serve to fasten paper to wood; the middling for wool-cards, &c. and the larger for upholsterers and pumps. Nails are said to be toughened when too brittle, by heating them in a fire-shovel, and putting some tallow or grease among them.

NAIS, in natural history, a genus of the Vermes Mollusca class and order. Body creeping, long, linear, pellucid, depressed; peduncles, or feet, with small bristles on each side. There are ten species; N. digilata, has single lateral bristles; tail laciniate. It is found in stagnant waters, or the sandy sediment of rivers, with its head attached to the stalk of aquatic plants. It is not half an inch long.

NAISSANT, in heraldry, is applied to any animal issuing out of the midst of some ordinary, and showing only his head, shoulders, fore-feet, and legs, with the tip of his tail, the rest of his body being hid in the shield, or some charge upon it; in which it differs from issuant, which denotes a living creature arising out of the bottom of any ordinary or charge.

NAKED, in architecture, is the surface or plain from whence the projectures arise, or which serves as a ground to the projectures. Thus, we say the foliages of a capital ought to answer to the naked of a column, and that a pilaster ought to exceed the naked of the wall by so many inches.

NAMA, in botany, a genus of the Pentandria Digynia class and order. Natural order of Succulentæ. Convolvuli, Jussieu. Essential character: calyx five-leaved; co-

N.

N, Or *n*, the thirteenth letter, and tenth consonant of our alphabet: it is a liquid, the sound of which is formed by forcing the voice strongly through the mouth and nostrils; being at the same time intercepted by applying the tip of the tongue to the fore-part of the palate, with the lips open. It suffers no consonant immediately after it, in the beginning of words and syllables; nor any before it, except *g*, *k*, and *s*; as in *gnaw*, *know*, *snow*, &c. as a numeral, N stands for 900; and with a dash over it, thus $\overline{N}$, for 900,000; N, or N°, stands for numero, *i. e.* in number; and N. B. for nota bene, note well, or observe well.

NABOB, a corruption from nawaub, the plural of naib. The title means deputed, but it is often assumed in India without a right to do it. As the real signification and import of this word are not generally known, we shall extract a passage out of Mr. Orme's "History of the Carnatic," that will place them in the clearest point of view: "Most of the countries which have been conquered by the Great Mogul in the peninsula of India, are comprised under one viceroyalty, called from its situation, Decan, or South. From the word soubah, signifying a province, the viceroy of this vast territory is called soubadar, and by Europeans, improperly, soubah. Of the countries under his jurisdiction, some are entirely subjected to the throne of Delhi, and governed by Mahomedans, whom Europeans improperly call Moors; whilst others remain under the government of their original Indian princes, or rajahs, and are suffered to follow their ancient modes, on condition of paying tribute to the Great Mogul. The Moorish governors depending on the soubah, assume, when treating with their inferiors, the title of nabob, which signifies deputy: but this in the registers of the throne (of Delhi) is synonimous to Soubadar, and the greatest part of those who style themselves nabobs are ranked at Delhi under the title of phous-dar, which is much inferior to that which they assume. The Europeans established in the territories of these pseudo-nabobs (if we may be allowed the expression) following the example of the natives with whom they have most intercourse, have agreed in giving them the title they so much affect.

"A nabob ought to hold his commission from Delhi, and if, at his death, a successor has not been previously appointed by the Great Mogul, the soubah has the right of naming a person to administer the nabobship until the will of the sovereign is known; but a nabob thus appointed by a soubah is not deemed authentically established until he is confirmed from Delhi. The soubah receives from the several nabobs the annual revenues of the crown, and remits them to the treasury of the empire. The nabobs are obliged to accompany him in all military expeditions within the extent of his viceroyalty, but not in any without that extent. These regulations were intended to place them in such a state of dependence on the soubah, as shall render them subservient to the interest of the empire, and at the same time leave them in a state of independence, which would render it difficult for the Soubah to make use of their assistance to brave the throne. Nabobs, however, have kept possession of their governments in opposition both to the Soubah and the throne; and what is more extraordinary in the offices of a despotic state, both soubahs and nabobs have named their successors, who have often succeeded with as little opposition as if they had been the heirs apparent of an hereditary dominion."

NABONASSAR, or *Æra of Nabonassar*, a method of computing time from the commencement of Nabonassar's reign. The epocha of Nabonassar is of the greater importance, as Ptolemy and other astronomers account their years from it.

NADIR, in astronomy, that point of the heavens which is diametrically opposite to the zenith, or point directly over our heads. The zenith and nadir are the two poles of the horizon.

NAJAS, in botany, a genus of the Dioecia Monandria class and order. Natural order of Inundatæ. Naiades, Jussieu. Essential character: male, calyx cylindric, bifid; corolla four-cleft; filament none: female, ca-

lyx none; corolla none; pistil one; capsule ovate; one-celled. There is but one species, viz. N. marina, which, according to Jussieu, has three whorled sheathing leaves, the flowers axillary, sessile; the filament in the male flowers long, with a four-valved anther, which is the four-cleft corolla of Linnæus; in the female flowers two stigmas, and one nut, or four seeds. Native of the sea coast of Europe; in the canal between Pisa and Leghorn; and in the Rhine, near Basle.

NAIL. See ANATOMY.

The nails have been chemically examined, and are found to be composed chiefly of a membranous substance, which possesses the properties of coagulated albumen. They contain also a little phosphate of lime. Water softens but does not dissolve them. They are readily dissolved and decomposed by concentrated acids and alkalies. It is pretty certain that they are composed of the same substances as HORN, which see. Under the head of nails must be comprehended the talons and claws of the inferior animals, and likewise their hoofs, which differ in no respect from horn.

NAILS, in building, &c. small spikes of iron, brass, &c. which being driven into wood, serve to bind several pieces together, or to fasten something upon them. The several sorts of nails are very numerous: as 1. Back and bottom nails; which are made with flat shanks to hold fast, and not open the wood. 2. Clamp-nails, for fastening the clamps in buildings, &c. 3. Clasp-nails, whose heads clasping and sticking into the wood, render the work smooth, so as to admit a plane over it. 4. Clench-nails, used by boat and barge builders, and proper for any boarded buildings that are to be taken down, because they will drive without splitting the wood, and draw without breaking; of these there are many sorts. 5. Clout-nails, used for nailing on clouts to axle-trees. 6. Deck-nails, for fastening of decks in ships, doubling of shipping, and floors laid with planks. 7. Dog-nails, for fastening hinges on doors, &c. 8. Flat-points, much used in shipping, and are proper where there is occasion to draw and hold fast, and no conveniency of clenching. 9. Jobent-nails, for nailing thin plates of iron to wood, as small hinges on cupboard-doors, &c. 10. Lead-nails, for nailing lead, leather, and canvass, tohard wood. 11. Port-nails, for nailing hinges to the ports of ships. 12. Pound-nails, which are four-square, and are much used in Essex, Norfolk, and Suffolk, and scarcely any where else, except for pailing. 13. Ribbing-nails, principally used in ship building, for fastening the ribs of ships in their places. 14. Rose-nails, which are drawn four-square in the shank, and commonly in a round tool, as all common two-penny nails are; in some countries all the larger sort of nails are made of this shape. 15. Rother-nails, which have a full head, and are chiefly used in fastening rother-irons to ships. 16. Round head nails, for fastening on hinges, or for any other use where a neat head is required; these are of several sorts. 17. Scupper nails, which have a broad head, and are used for fastening leather and canvass to wood. 18. Sharp-nails, these have sharp points and flat shanks, and are much used, especially in the West Indies, for nailing soft wood. 19. Sheathing-nails, for fastening sheathing-boards to ships. 20. Square-nails, which are used for hard wood, and nailing up wall-fruit. 21. Tacks, the smallest of which serve to fasten paper to wood; the middling for wool-cards, &c. and the larger for upholsterers and pumps. Nails are said to be toughened when too brittle, by heating them in a fire-shovel, and putting some tallow or grease among them.

NAIS, in natural history, a genus of the Vermes Mollusca class and order. Body creeping, long, linear, pellucid, depressed; peduncles, or feet, with small bristles on each side. There are ten species; N. digitata, has single lateral bristles; tail laciniate. It is found in stagnant waters, or the sandy sediment of rivers, with its head attached to the stalk of aquatic plants. It is not half an inch long.

NAISSANT, in heraldry, is applied to any animal issuing out of the midst of some ordinary, and showing only his head, shoulders, fore-feet, and legs, with the tip of his tail, the rest of his body being hid in the shield, or some charge upon it; in which it differs from issuant, which denotes a living creature arising out of the bottom of any ordinary or charge.

NAKED, in architecture, is the surface or plain from whence the projectures arise, or which serves as a ground to the projectures. Thus, we say the foliages of a capital ought to answer to the naked of a column, and that a pilaster ought to exceed the naked of the wall by so many inches.

NAMA, in botany, a genus of the Pentandria Digynia class and order. Natural order of Succulentæ. Convolvuli, Jussieu. Essential character: calyx five-leaved; co-

rolla five-parted; capsule one-celled, two-valved. There is but one species, *viz.* N. Jamaicensis, an annual little plant, spreading much about the root; it is seldom more than five or six inches in length, with the stalk and branches margined.

NAME, denotes a word whereby men have agreed to express some idea; or which serves to signify a thing or subject spoken of. This the grammarians usually call a noun, though their noun is not of quite so great an extent as our name. See GRAMMAR.

NANDINA, in botany, a genus of the Hexandria Monogynia class and order. Essential character: calyx many-leaved, imbricate; corolla six-petalled. There is but one species, *viz.* N. domestica, a native of Japan.

NAPÆA, in botany, a genus of the Dioecia Monadelphia class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx five-cleft; petals five: male, stamina monadelphous, very many fertile; styles several, barren: female, stamina monadelphous, very many barren; styles several, longer than the stamens; capsule orbicular, depressed, ten-celled; seeds solitary. There are two species, *viz.* N. lævis, smooth napæa, and N. scabra, rough napæa. Both these plants grow naturally in Virginia and many parts of North America; from their bark a kind of hemp may be procured, such as many of the malvaceous tribe afford.

NAPTHA, in chemistry, one of the bitumens which has been used much lately in the experiments on the newly discovered metals of POTASSIUM and SODAIUM, which see. Naptha is of a light colour, more or less transparent, perfectly thin and liquid, and so light as to float on water; it is odoriferous, volatile, and inflammable. See BITUMEN, PETROLEUM, &c.

NARCISSUS, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Spathaceæ. Narcissi, Jussieu. Essential character: petals six-equal; nectary funnel-form, one-leafed; stamina within the nectary. There are fifteen species, of which we shall notice the N. tazetta, polyanthus narcissus. It is a native of Spain and Portugal, the South of France, Italy, and Japan; it has a large roundish bulb, from which proceed three or four narrow leaves; the scape, or flower-stalk, is upright, angular, concave, from twelve to eighteen inches in height; flowers very fragrant, clustered, from seven to ten coming out of one spathe of a white or yellow colour.

There is a greater variety of the polyanthus narcissus than of all the other species, for the flowers being very ornamental, and appearing early in the spring, the florists in Holland, Flanders, and France, have taken great pains in cultivating and improving them.

NARCOTIC *principle*. See OPIUM.

NARCOTICS, in medicine, soporiferous medicines, which excite a stupefaction.

NARDUS, in botany, *mat-grass*, a genus of the Triandria Monogynia class and order. Natural order of Gramina, Gramineæ, or Grasses. Essential character: calyx none; corolla two-valved. There are four species.

NARRATION, in oratory and history, a recital or rehearsal of a fact as it happened, or when it is supposed to have happened. Narration is of two kinds, either simple or historical, as where the auditor or reader is supposed to hear or read of a transaction at second hand; or artificial and fabulous, as where their imaginations are raised, and the action is as it were re-acted before them.

NATROLITE, in mineralogy, a species of the zeolite family, was first described and analysed by Klaproth, who gave it the name which it bears, on account of the great proportion of soda which it contains. It occurs massive, and in its fracture presents straight or diverging fibres; its colour is light yellow, with little lustre; it is striped, and the stripes are curved in the direction of the external surface. It fuses very readily before the blow-pipe. It consists of

Silica	48
Alumina	24.25
Soda	16.5
Oxide of Iron	1.75
Water	9
	99 .5
Loss	5
	100

NATRON, in chemistry, a term frequently given to soda, upon the supposition that it is the natron or nitrum of the ancients. See SODA. Natural natron occurs either as an efflorescence on the surface of the soil, or on decomposing rocks of particular kinds, or on the sides and bottoms of lakes that become dry during the summer. In

Hungary the natron lakes are very numerous, and afford a vast quantity annually. In some places it effervesces on the surface of the soil, heath, &c. It is even found efflorescing on meadows, where it is renewed every spring. About sixty miles north-east of Grand Cairo, in Egypt, there is a lime-stone valley in which there are several extensive natron lakes, which become dry during the summer season, and leave their sides and bottoms covered with a great quantity of soda or natron.

NATURAL *history*. Natural history, taken in its most extensive sense, signifies a knowledge and description of the whole universe. Facts respecting the heavenly bodies, the atmosphere, the earth, and indeed all the phenomena which occur in the world, and even those which relate to the external parts, as well as the actions of man himself, so far as reason can discover them, belong to the province of natural history. But when we leave the simple recital of effects, and endeavour to investigate the causes of such phenomena, we over step the boundaries of natural history, and enter on the confines of philosophy. This science, it must be evident, according to the above definition, is as extensive as nature itself; but in a more appropriate and limited sense, it treats of those substances of which the earth is composed, and of those organized bodies, whether vegetable or animal, which adorn its surface, soar into the air, or dwell in the bosom of the waters.

In this restricted sense natural history may be divided into two heads; the first teaches us the characteristics, or distinctive marks of each individual object, whether animal, vegetable, or mineral; the second renders us acquainted with all its peculiarities, in respect to its habits, its qualities, and its uses. To facilitate the attainment of the first, it is necessary to adopt some system of classification, in which the individuals that correspond in particular points may be arranged together, and with this view we have preferred that of Linnæus, as being the most simple and perfect of any that has yet been presented to the public.

A knowledge of the second head can only be acquired by a diligent and accurate investigation of each particular object; for this we must refer the reader to the several genera described in the course of the work, under which we have endeavoured to give a brief account of the interesting and more material facts connected with each genus.

The study of natural history consists in the collection, arrangement, and exhibition of the various productions of the earth. These are divided into three great kingdoms of nature, the boundaries of which meet in the ZOOPHYTES, which see.

Minerals occupy the interior parts of the earth, in rude and shapeless masses. They are concrete bodies, destitute of life and sensation. See MINERALOGY, and the several genera of minerals.

Vegetables clothe its surface with verdure, imbibe nourishment through their bibulous roots, respire by means of leaves, and continue their kind by the dispersion of seed within prescribed limits. They are organized bodies, possessing life, but not sensation. See BOTANY.

Animals inhabit the exterior parts of the earth, respire, and generate eggs; are impelled to action by hunger, affections, and pain, and by preying on other animals and vegetables, restrain within proper limits and proportions the numbers of both. They possess organized bodies, enjoy life and sensation, and have the power of loco-motion.

Man, who rules and subjugates all other beings, is by his wisdom alone capable of forming just conclusions from such natural bodies as present themselves to his senses. Hence an acquaintance with these bodies, and the capability from certain marks imprinted on them by the hand of nature, to distinguish them from each other, and to affix to each its proper name, constitute the first step of knowledge. These are the elements of this science; this is the great alphabet of nature, for if the name be lost, the knowledge of the object must be lost also.

The method pursued in natural history indicates that every body may, on inspection, be known by its peculiar name, and this points out whatever the industry of man has been able to discover respecting it, so that amid apparent confusion, the greatest order and regularity are discernible.

The Linnæan system is divided into classes, orders, genera, species, and varieties, to each of which their names and characters are affixed. In this arrangement the classes and orders are arbitrary, the genera and species are natural.

Of the three grand divisions of the imperium naturæ, above referred to, the animal kingdom stands highest in the scale, next

to it the vegetable, and lastly the mineral kingdom.

To the vegetable and mineral kingdoms we have already referred under the distinct articles BOTANY and MINERALOGY, with regard to the animal kingdom we may observe, that animals enjoy sensation by means of a living organization, animated by a medullary substance, perception by nerves, and motion by the exertion of the will. They are furnished with members for the different purposes of life, organs for their different senses, and faculties or powers for the application of their different perceptions. They all originate *ab ovo.* Their external and internal structure, habits, instincts, and various relations to each other, will be found under the different genera. See also ANATOMY, COMPARATIVE ANATOMY, PHYSIOLOGY, &c.

The following is a brief abstract of the arrangement pursued by Linnæus in his division of the animal kingdom.

CLASS I. MAMMALIA.

ORDER.

Primates	Pecora
Bruta	Belluæ
Feræ	Cete
Glires	

CLASS II. AVES.

ORDER.

Accipetres	Grallæ
Picæ	Gallinæ
Anseres	Passeres

CLASS III. AMPHIBIA.

ORDER.

Reptilia	Serpentes

CLASS IV. PISCES.

ORDER.

Apodes	Abdominales
Jugulares	Branchiostegi
Thoracici	Condropterygii

CLASS V. INSECTA.

ORDER.

Coleoptera	Hymenoptera
Hemyptera	Diptera
Lepidoptera	Aptera
Neuroptera	

CLASS VI. VERMES.

ORDER.

Intestina	Zoophyta
Mollusca	Infusoria
Testacea	

For particular information respecting the characters of the different classes, orders, &c. the reader may consult the several articles.

NATURALIZATION, is when an alien born is made the king's natural subject.

Hereby an alien is put in the same state as if he had been born in the king's ligeance, except only, that he is incapable of being a member of the Privy Council, or Parliament, and of holding any office or grant. No bill for a naturalization, can be received in either House of Parliament, without such disabling clause in it; nor without a clause disabling the person from obtaining any immunity in trade thereby, in any foreign country, unless he shall have resided in Britain seven years next after the commencement of the session in which he is naturalized. Neither can any person be naturalized, or restored in blood, unless he have received the sacrament within one month before the bringing in of the bill, and unless he also take the oaths of allegiance and supremacy in the presence of the Parliament. See ALIEN.

NATURAL *philosophy*, otherwise called *physics*, is that science which considers the powers of nature, the properties of natural bodies, and their actions upon one another. Laws of nature are certain axioms, or general rules, of motion and rest, observed by natural bodies in their actions upon one another. Of these laws Sir I. Newton has established three: — Law 1. That every body perseveres in the same state, either of rest or uniform rectilinear motion, unless it is compelled to change that state by the action of some foreign force or agent. Thus, projectiles persevere in their motions, except so far as they are retarded by the resistance of the air and the action of gravity: and thus a top, once set up in motion, only ceases to turn round because it is resisted by the air, and by the friction of the plane upon which it moves. Thus also the larger bodies of the planets and comets preserve their progressive and circular motions a long time undiminished in regions void of all sensible resistance. As body is passive in receiving its motion, and the direction of its motion, so it retains them, or perseveres in

them, without any change, till it be acted upon by something external. Law 2. The motion, or change of motion, is always proportional to the moving force by which it is produced, and in the direction of the right line in which that force is impressed. If a certain force produce a certain motion, a double force will produce double the motion, a triple force triple the motion, and so on. And this motion, since it is always directed to the same point with the generating force, if the body were in motion before, is either to be added to it, as where the motions conspire; or subtracted from it, as when they are opposite; or combined obliquely, when oblique: being always compounded with it according to the denomination of each. Law 3. Re-action is always contrary and equal to action; or the actions of two bodies upon one another are always mutually equal, and directed contrary ways, and are to be estimated always in the same right line. Thus, whatever body presses or draws another is equally pressed or drawn by it. So, if I press a stone with my finger, the finger is equally pressed by the stone: if a horse draw a weight forward by a rope, the horse is equally opposed or drawn back towards the weight; the equal tension or stretch of the rope hindering the progress of the one as it promotes that of the other. Again, if any body, by striking on another, do in any manner change its motion, it will itself, by means of the other, undergo also an equal change in its own motion, by reason of the equality of the pressure. When two bodies meet, each endeavours to persevere in its state, and resists any change; and because the change which is produced in either may be equally measured by the action which it excites upon the other, or by the resistance which it meets with from it, it follows that the changes produced in the motions of each are equal, but are made in contrary directions: the one acquires no new force but what the other loses in the same direction; nor does this last lose any force but what the other acquires; and hence, though by their collisions motion passes from the one to the other, yet the sum of their motions, estimated in a given direction, is preserved the same, and is unalterable by their mutual actions upon each other. In these actions the changes are equal; not those, we mean, of the velocities, but those of the motions, or momenta; the bodies being supposed free from any other impediments. For the changes of velocities, which are likewise made contrary ways, inasmuch as the motions are equally changed, are reciprocally proportional to the bodies or masses.

NATURALIST, a person well versed in the study of nature, and the knowledge of natural bodies, especially in what relates to animals, vegetables, metals, minerals, and stones. See NATURAL HISTORY.

NATURE, according to Mr. Boyle, has eight different significations; it being used, 1. For the author of nature, whom the schoolmen call *natura naturans*, being the same with God. 2. By the nature of a thing, we sometimes mean its essence; that is, the attributes which make it what it is, whether the thing be corporeal or not; as when we attempt to define the nature of a fluid, of a triangle, &c. 3. Sometimes we confound that which a man has by nature with what accrues to him by birth; as when we say, that such a man is noble by nature. 4. Sometimes we take nature for an internal principle of motion; as when we say, that a stone by nature falls to the earth. 5. Sometimes we understand by nature the established course of things. 6. Sometimes we take nature for an aggregate of powers belonging to a body, especially a living one; in which sense physicians say, that nature is strong, weak, or spent; or that, in such and such diseases, nature left to herself will perform the cure. 7. Sometimes we use the term nature for the universe, or whole system of the corporeal works of God; as when it is said of a phœnix, or chimera, that there is no such thing in nature. 8. Sometimes too, and that most commonly, we express by the word nature a kind of semideity, or other strange kind of being.

If, says the same philosopher, I were to propose a notion of nature, less ambiguous than those already mentioned, and with regard to which many axioms, relating to that word, may be conveniently understood, I should first distinguish between the universal and the particular nature of things. Universal nature I would define to be the aggregate of the bodies that make up the world, in its present state, considered as a principle; by virtue whereof they act and suffer, according to the laws of motion, prescribed by the author of all things. See the articles BODY, INERTIA, MOTION, &c. And this makes way for the other subordinate notion; since the particular nature of an individual consists in the general nature, applied to a distinct portion of the universe; or, which is the same thing, it is a particular

assemblage of the mechanical properties of matter, as figure, motion, &c.

Those who desire a more particular discussion of each of these opinions, may consult Boyle's "Free Inquiry into the Vulgar Notion of Nature." By a modern French writer we have the following account of Nature. This word, which we so frequently employ, must only be regarded as an abridged manner of expressing sometimes the results of the laws to which the Supreme Being has subjected the universe; at others, the collection of beings which have sprung from his hands. Nature, contemplated thus under its true aspect, is no longer a subject of cold and barren speculation with respect to morals: the study of its productions, or of its phenomena, is no longer bounded to enlightening the mind; it affects the heart, by kindling therein sentiments of reverence and admiration at the sight of so many wonders, bearing such visible characters of an infinite power and wisdom. Such was the disposition that was cultivated by the great Newton, when, after having considered the mutual connection which subsists between effects and their causes, which makes all the particulars concur to the harmony of the whole, he elevated his mind to the idea of a Creator and Prime Mover of matter, and enquired of himself why nature had made nothing in vain? whence it happens that the sun, and the planetary bodies, gravitate the one towards the other, without any intermediate dense matter? and, how it could be possible that the eye should be constructed without the knowledge of optics, or the organ of hearing without the intelligence of sounds?

NAVAL *affairs*, comprehend whatever relates to navigation, ship-building, sailors, &c. See NAVIGATION, SHIP-BUILDING.

NAUCLEA in botany, a genus of the Pentandria Monogynia class and order. Natural order of Aggregatæ. Rubiaceæ, Jussieu. Essential character; corolla, funnel-form; seed one, inferior, two-celled; receptacle common globular. There are four species, of which N. parviflora is a beautiful large tree, growing naturally in almost every part of the coast of Coromandel, but chiefly among the mountains, flowering during the cold season; the wood is of a light chesnut colour, firm and close grained; it is used for various purposes, where it can be kept dry; if exposed to moisture it very soon decays. It is called by the Telingas, bota cadamic.

NAUDE (PHILIP), in biography, an able professor of mathematics at Berlin in the seventeenth and early part of the eighteenth century, was born at Metz in Lorrain, in the year 1654. At the age of about twelve, he was taken into the service of the court of Eysenach, in the capacity of page, and attendant on the young princes. In this situation his behaviour secured him the esteem of all who knew him; and while he continued here he learned the German language, which afterwards proved of great use to him. When he had spent about four years at Eysenach, his father chose to take him home; but how he was employed during the next fifteen years of his life we are not informed. We are only told that his father had neither the intention nor the m[illegible]s of affording him a learned education; b[illegible]at, notwithstanding the disadvantages o[illegible] condition, having an unconquerable th[illegible] for knowledge, he became his own ma[illegible]r, and made considerable proficiency in [illegible]fferent branches of learning, particular[illegible] in the mathematical sciences. As he was in principle a Protestant, when the edict of Nantes was revoked in 1685, he left France with his wife and young child about nine months old, and resided about two years at Hanau. Hence he removed to Berlin, where he contracted an intimacy with M. Langerfield, mathematician to the court, and tutor to the pages. This gentleman, who knew how conversant he was with the sciences, advised him to open a mathematical school, and recommended pupils to him. In 1687, he received an appointment to teach arithmetic and the elements of the mathematics at the college of Joachim; and in 1690, he was made secretary interpreter. Upon the death of M. Langerfield not many years afterwards, M. Naude succeeded him in 1696, both in his employments at court, and the professorship in the Academy of Sciences. In 1701 he was elected a member of the Academy of Sciences; and in 1704, when the king founded the Academy of Princes, M. Naude was attached to it by a special patent, as professor of mathematics. He died at Berlin in 1729, at the age of seventy-five, highly respected for his integrity and general excellence of character. Though the mathematics chiefly occupied his attention, he was not unacquainted with the other sciences, and as he was zealous for the religion which he professed, he had made divinity his particular study, and written several treatises on religious and moral subjects. In mathematics, his sole

publication was "Elements of Geometry" in quarto, written in German, and printed at Berlin for the use of the Academy of Princes; and some smaller pieces, which appeared at different periods in the "Miscellanea Berolinensia." Among his theological and moral productions were, "Sacred Meditations," 1690, 12mo; "Evangelical Morality," 1699, in two volumes, 12mo.; "The Sovereign Perfection of God in his Divine Attributes, and the perfect Integrity of the Scriptures, in the Sense maintained by the first Reformers," 1708, in two volumes, 12mo. written against M. Bayle; which, being attacked in a 12mo. pamphlet, he defended in "A Collection of Objections to the Treatise on the Sovereign Perfection of God, with Answers to the same," 1709, 12mo.; "An Examination of two Treatises of M. de Placette," 1713, in two volumes, 12mo; "Dialogue in Solitude," partly translated from the Dutch of William Teelink, 1717, 12mo.; "A Refutation of the Philosophical Commentary," 1718, 12mo. &c.

NAVEL, in anatomy, the centre of the lower part of the abdomen; being that part where the umbilical vessels passed out of the fœtus to the placenta of the mother. See ANATOMY, MIDWIFERY, &c.

NAVIGATION is the art of conducting a vessel from one port to another by observation of the heavenly bodies, calculation of the distance, or way, made daily, and by steering such a course, under guidance of the compass, as may lead, in the most direct manner, from the place quitted to the ship's destination. Before we proceed on this topic, it may be proper to stipulate for a competent knowledge of geography; especially of the division of our globe by the various circles, and meridians, by which it is intersected in theory. The student must also be thoroughly acquainted with all relating to the needle; in particular the dip and variation, and be able to take an account of the ship's progress numerically, or, as it is termed in dead-reckoning; and if he should possess some skill in geometry and trigonometry, he will find that his task is more easily performed, and that he will, in due time, render himself conspicuous in that branch of his honourable profession.

We shall preface this subject with a few details that will be found useful: they will prepare the way for further operations; and serve in addition to what has been premised in regard to mathematical acquirement, to give such a solid foundation as will leave the reader at no loss as he proceeds in the more intricate parts of the science. We shall commence with the absolute necessity of readily boxing, *i. e.* telling the points of the compass. Under the head of MAGNETISM, we have slightly touched on this subject, but shall now explain that each quarter of the compass card, or index, is divided into eight equal portions called points. The four cardinal points, *i. e.* North, South, East and West, form the terminations of two diameters standing at right angles: the four points ascertained by dividing the several quadrants, into two equal portions each, give compound-points; which are named after the two adjunct cardinals respectively; observing that North and South have precedence in each designation. Thus the mid-point between North and East is called "North East, that between North and West is called "North West;" that between South and East is called "South East;" and that between South and West is called "South West." By this process we have divided the circumference into eight equal parts. Now let each segment between the several cardinals, and their compounds, be subdivided into four equal portions; so that the whole circle may be partitioned into thirty-two parts; *i. e.* eight between each of the adjunct cardinals: the two points adjunct to North will be "North by East," and "North by West;" these adjunct to South will be "South by East," and "South by West;" those adjunct to East will be "East by North," and "East by South;" while the adjuncts to West will be "West by North," and "West by South." The two adjuncts to the compounds will be as follow; to North East they will be "North East by North," and "North East by East;" to South East they will be "South East by South," and "South East by East;" to North West they will be "North West by North," and "North West by West;" and to South West they will be "South West by South," and "South West by West." There yet remain eight points, equidistant between the several cardinals and the compounds: these have their designations made by prefixing, to that of the adjunct compound, that of the cardinal to which it is nearest. Thus between North and North West, the point is called "North, North West," and that between North West and West, is called "West, North West:" thus we have "North, North East," and "East

North East;" "South, South West," and "West, South West;" "South, South East," and "East, South East."

In Plate IX. Miscel. fig. 9 and 10, we have given figures of a compass and compass-card, according to the mariner's arrangement just described, in which only the initials [illegible] shewn: the North point being disting[illegible]d, as it always is, by a fleur de lys, [illegible] particular indicial ornament. For [illegible] particulars, see MARINER'S c[illegible]

[illegible] been the more particular in d[illegible] the formation of the compass car[illegible] perfect knowlege of that imp[illegible] indispensably necessary for [illegible] the study, or follow the pract[illegible]n. M[illegible] have ex[illegible] tie[illegible]ad-stone, an[illegible] the [illegible] well as of [illegible] varia[illegible] exists [illegible] true [illegible] apparent [illegible] direc[illegible]sted by the compass. The[illegible]iefly observe, that varia[illegible]erly, or Westerly; and, [illegible]ails, must be computed in [illegible]; always making allo[illegible]nd d[illegible] a[illegible] o[illegible] in[illegible] inste[illegible]d[illegible] by th[illegible]e v[illegible] grees [illegible]erly, or, North half [illegible], i. e. half a [illegible] of North, in which direction the [illegible] point would be found by observation of the heavenly bodies. Currents must also have allowance made for them according to their bearing, or the points to which they run: it is self-evident, that if such were not duly ascertained, and set off from the dead reckoning, the ship's place would never be accurately laid down, and destruction would inevitably follow the neglect.

The way, or distance, the ship sails within the day, is ascertained by means of a small piece of board called the LOG (which see), that being fastened to a thin, but stout line, and lowered over the stern, occasions the line to run off from a large reel. The line being marked at certain distances with small pieces of string, whereon, one, two, three, &c. knots are made, at distances corresponding with the rate per hour, and the persons who superintends the process, having a minute, or a half minute glass; the log is allowed to run the line from the reel, during such interval; the number of knots, on the proximate string, indicating the number of miles the ship sails within the hour. Hence the techinical term of so many "knots per hour;" or "an eight knot breeze," &c.

The whole world is supposed to be comprized under a circle, which in every direction, contains 360 degrees of equal measurement. Such as pass through the meridian of any place, and from North to South, cutting the equator at right angles, are called meridional lines, and are each divided into nine degrees, counting from the line towards the poles respectively: those proceeding to the North are called degrees of North latitude; those towards the South [illegible] called degrees of South latitude. In [illegible]espect all civilized nations are agreed; [illegible]n their estimation of longitude, they [illegible]ally differ, each taking some parti[illegible] point within their own dominions [illegible]ro, and counting 180 degrees East, [illegible]s many West; calling the former East [illegible]tude, the latter West longitude. Con[illegible]ntly the union of those adverse desig[illegible]ns takes place at the antipodes of the [illegible] from which they proceeded; and the [illegible]ent a vessels passes 180 degrees, either [illegible] she enters upon 179 of the opposite [illegible] circle, and reckoning the degrees of [illegible]de are equal from the equator to the [illegible] and each in general measures about [illegible]f British statute miles. But the de[illegible] of longitude vary greatly; decreasing regularly from the equator to the poles, where they all meet and are as it were annihilated. The regular declension of the circles of longitude, which are the same as parallels of latitude, may be seen under the head of DIALLING; where in the construction of lines of latitude, their gradual decrease is fully exhibited: see also LONGITUDE, for a table of longitudes in various latitudes.

A rhumb-line is a right line drawn from the centre of the compass to the horizon, and is named from that point of the horizon it falls upon. The course is the angle which any rhumb-line makes with the meridian, and is sometimes reckoned in degrees, and sometimes in points of the compass; so that if a ship sail upon the second rhumb, or N. N. E. the course is 22° 30', and so for any other. When a ship makes a direct course from one point or port to another, and that there is no current nor any variation of the compass, she sails "on a rhumb:" that is, she is guided invariably from one to the

other throughout her course by one point of the compass, being governed throughout her passage by that line only. This is different from what is called traverse sailing, which arises from adverse winds, or sometimes from currents, and obliges a vessel to change her course occasionally; especially where the vicinity of land renders it necessary to steer at times differently; lest the current, which generally changes from one side or direction to another, should set her against the shore. When the wind is diametrically, or obliquely against a ship's direct course, she must make traverses, *i. e.* zig zags, which is effected by laying her head as close to the wind as may allow her sails to be filled when close hauled; (see Plate XI. Miscel. fig. 12.) in which A is the place of departure, B the point of destination, from which the wind blows direct, and A *b*, *b c*, *c* B, &c. the course the ship must steer to arrive at B. Square rigged ships generally can lay within six points of the wind; but sloops, &c. commonly lay up within four points and a half. When working in this manner it is called "beating," or "plying to windward:" when the wind blows straight upon the side of the vessel, it is said to be "on the beam;" when between her side and stern, it is called "a quartering wind," or "on her quarter;" when direct astern, or near it, she is said to be "before the wind," or to "sail large." When the wind from being fair becomes suddenly foul, it is said to "take her aback."

In traverse sailing the vessel's head is usually turned up "into the wind" when she is "put about." This is called "tacking;" but if, instead of "throwing her up" in that manner, she is allowed to go round from the wind until it comes or is met by her on the other side, it is called "wearing." When she has the wind on her starboard, or right bow, she is said to "have her starboard tacks aboard," and *vice versa* when the larboard, or left, bow is to the wind. To know how close a ship will lay to the wind, observe the course she goes on each tack, say north on one, and south-west on the other; divide in the middle, and her course will appear to be west-north-west. But allowance must be made for lee-way, which is the loss made by the impression made on the vessel as she is working to windward; when the wind presses her from the direct line of her course, and occasions her to "drift to leeward." See LEEWAY.

The following is the established rule for laying down a traverse course on paper. Having drawn the meridian and parallel of latitude (or east and west line) in a circle representing the horizon of the place, mark in the circumference the place of the wind, that is, the point from which it blows; draw your rhumb passing through the place bound to, and lay thereon the distance of that place from the centre; on each side of the wind lay off in the circumference those points, or degrees, that shew how near the wind the vessel can lie, and draw their rhumbs. Now the first course will be one of these rhumbs, according to the tack the ship first sails upon; when she goes on the other tack, it will be at such an angle as may correspond with her ability to lay near the wind; but, in general, for square-rigged vessels the angle should be twelve points, (*i. e.* six for the distance on each tack, as shewn in fig. 12.) But where the wind is not directly adverse, it would be improper to make the tacks towards both rhumbs of equal duration or length. Therefore that tack should be longest which lays nearest the intended course; the other (*i. e.* "the board") should be short, so that the vessel should not go too far from the intention, but adhere as much as may be practicable to the rhumb of her course, as shewn in fig. 13, in which the arrow shews the wind's locality at three points east of the destination B.

To resolve a traverse, is to reduce and bring several courses into one; the courses are known by the compass, the distance by the log: while the dead-reckoning they produce is corrected by daily observation of the sun and other planets whenever opportunity offers.

In constructing figures relating to a ship's course, let the top of the paper always represent the north: your meridian is described perpendicular thereto, and your chart may either be in squares, for degrees, or five or ten degrees, or it may be divided according to the projected tables now in common use (see LONGITUDE), and which is by far the best, as it shews the real distances and bearings, according to the actual positions of places, as proved by observation. In that table the letters D. L. imply the degree of latitude, measured from the equator, either northwards or southwards; in the columns of miles corresponding thereto, you will see how many miles, of sixty to a degree, called geographical miles, are contained in each degree of longitude under such latitudes. Thus, if I would know how

many miles are contained in a degree in latitude 18; I find there are 57.06. Therefore it must be evident, that, as the latitude recedes from the equator, the smaller the degrees of longitude become: hence, if a vessel could sail round the north pole in latitude 80°, where there are only 10° 42′ miles in a degree of latitude, and were to run 123 miles in the twenty-four hours, she would sail ten times round the pole, and indeed round the world, in that time, and see the sun rise and set no less than twelve times!

From this we are satisfied that the old practice of laying down a chart, or map, in square degrees was erroneous in the extreme; and that what is called "Mercator's projection," which gives every degree its just and exact value in breadth, at both its northern and its southern extremities, is the only correct and rational mode of description.

We shall now give the reader a few examples under the head of plane sailing, which supposes the earth to be a perfect level, or plane. This is but the application of plane trigonometry to the solution of the several variations; where the hypothenuse, or longest side, is always the rhumb on which the ship's course lies. The perpendicular is the difference of latitude counted on the meridian, and the base the departure (which is either easting or westing) counted from the meridian. The angle opposite the base is that which the ship makes with the meridian: the angle at the perpendicular is the complement of the course; which, taken together, always make 90 degrees, or eight points. When the course is given in degrees, they must be set off from a line of chords of 60, corresponding with the radius of the circle, or quadrant, drawn either easterly or westerly, as the ship's course may be, from the meridian. Where the course is given in points, it may be set down with its corresponding logarithm in points in the calculation, as found in the first page of logarithms in general. In all cases, wherever the complement course is used, the degrees, or points, put down, correspond with the course itself; yet the logarithm belonging to the complement of that course is taken.

Example 1. "Course and distance sailed being given, to find the difference of latitude, and the departure from the meridian." Suppose a ship from the Lizard, in the latitude of 49° 57′ north, sails S. W. by W. 496 miles; required the latitude come to, and her departure from the meridian. Draw the meridian, or difference of latitude; with the chord of 60° in your compasses, and one foot in C, (fig. 14) describe an arch: take 56° 15′, or five points, in your compasses, and lay off that distance upon the arch, from B C towards C A: through the point where it cuts draw the distance C A, upon which set off 496: from A let fall the perpendicular A B, the departure, and it is done. For A B, being measured on the same scale that A C was, will give the departure 412.4, and B C 275.6, for the difference of latitude.

Example 2. "Course and difference of latitude being given to find the distance run, and the departure from the meridian." If a ship runs S. E. by E. from 1° 45′ north [illegible]le, and then by observation is in [illegible] south latitude, required her distance [illegible]parture? As the ship has crossed the [illegible] *e.* the equator), the north latitude [illegible] must be added to the south latitude [illegible]; which makes the difference of lati[illegible] [illegible]4° 35′. Multiply that by 60, and t[illegible] appear 275 geographical miles. Now dra[illegible] B C (fig. 15) equal to 275; and B A, mak[illegible]g an angle with B C equal to five poi[illegible], or 56° 15′: upon C erect the perpendiculars C A, to join B A in A. Then will C A be 112, and A B 496 miles; therefore the ship's run has been 496 miles, and her departure from the meridian 411.6 easterly.

Example 3. "Course and departure being given, to find the distance and the difference of latitude." If a ship sails N. E. by E. ¾ E. from a port in 3° 15′ south latitude until she depart from her first meridian 412 miles, what latitude will she be in? Draw D A (fig. 16), upon which erect the perpendicular A B; draw the line A C, making an angle with A B equal to 64° 41′, corresponding with 5¾ points. At the distance of 412 miles draw D C, parallel to A B, to cut A C in C: through the point C draw B C parallel to A D, to cut the meridian A B. Thus A C will give 456 miles for the distance run, and A B 195 miles for difference of latitude.

Having said thus much by way of general information, we must refer those readers who are in search of extensive knowledge in the art of navigation to the several treatises which have been written by its professors; among which, we believe, those published by Mr. Nicholson and the late John Hamilton Moore have had the greatest character for utility and general accuracy. With respect to what appertains more to the ex-

amination of harbours, coasts, soundings, &c. we refer to SURVEYING.

Under the article QUADRANT the mode of taking observations at sea will be given, for ascertaining the latitude by solar observation.

NAUSEA, in medicine, a reaching, or propensity and endeavour to vomit, arising from a loathing of food, excited by some viscous humour that irritates the stomach.

NAUTILUS, in natural history, a genus of the Vermes Testacea class and order. Shell univalve, divided into several departments, communicating with each other by an aperture. There are more than thirty species, separated into sections. A. Spiral, rounded, with contiguous whorls. B. Spiral, rounded, with separated whorls. C. Elongated and straightish. N. pompilius, inhabits the Indian and African oceans; often very large, and finely variegated with brown flexuous streaks, spots, and marks, under the outer covering, which is white; within of a most beautiful pearly gloss. Of this species, the inhabitants of the east make drinking cups. N. spicula, aperture of the shell orbicular; whorl cylindrical: it inhabits the American and Indian oceans; about an inch in diameter; whitish within, shining like mother-of-pearl; orbicular; the whorls gradually decreasing inwards, the first a little straight; siphon contiguous to the walls of the shells.

NAVY, the fleet or shipping of a prince or state.

The management of the British navy royal, under the Lord High Admiral of Great Britain, is entrusted to principal officers and commissioners of the navy, who hold their places by patent. The principal officers of the navy are four; viz. the Treasurer, whose business it is to receive money out of the exchequer, and to pay all the charges of the navy, by warrant from the principal officers: Comptroller, who attends and comptrols all payment of wages, is to know the rates of stores, to examine and audite all accounts, &c.: Surveyor, who is to know the states of all stores, and see wants supplied, to estimate repairs, charge boatswains, &c. with what stores they receive, and at the end of each voyage to state and audite accounts: Clerk of the Acts, whose business it is to record all orders, contracts, bills, warrants, &c.

The Commissioners of the navy are five: the first executes that part of the Comptroller's duty which relates to the comptrolling the Victuallers' accounts; the second, another part of the said Comptroller's duty, relating to the account of the store-keepers of the yard; the third has the direction of the navy at the port of Portsmouth; the fourth has the same at Chatham; and the fifth at Plymouth.

There are also other Commissioners at large, the number more or less, according to the exigencies of public affairs; and since the increase of the royal navy, these have several Clerks under them, with salaries allowed by the King.

The victualling of the royal navy had formerly been undertaken by contract, but is now managed by Commissioners, who hold their office at Somerset House, Strand.

NEBULÆ, in astronomy. There are spots in the heavens called nebulæ, some of which consist of clusters of telescopic stars, others appear as luminous spots of different forms. The most considerable is one in the midway between the two stars on the blade of Orion's sword, marked θ by Bayer, discovered in the year 1656 by Huygen's; it contains only seven stars, and the other part is a bright spot upon a dark ground, and appears like an opening into brighter regions beyond.

Dr. Halley and others have discovered nebulæ in different parts of the heavens. In the "Connoisance des Temps," for 1783 and 1784, there is a catalogue of 103 nebulæ, observed by Messier and Mechain. But to Dr. Herschel we are indebted for catalogues of 2000 nebulæ, and clusters of stars, which he himself has discovered. Some of them form a round compact system, others are more irregular, of various forms, and some are long and narrow. The globular systems of stars appear thicker in the middle than they would do if the stars were all at equal distances from each other; they are, therefore, condensed toward the centre. That stars should be thus accidentally disposed is too improbable a supposition to be admitted; he supposes, therefore, that they are brought together by their mutual attractions, and that the gradual condensation towards the centre is a proof of a central power of such a kind. He observes, also, that there are some additional circumstances in the appearance of extended clusters and nebulæ, that very much favour the idea of a power lodged in the brightest part. For although the form of them be not globular, it is plain that there is a tendency to sphericity. As the stars in the same nebulæ must be very nearly all at the same relative distances from us, and they

appear nearly of the same size, their real magnitudes must be nearly equal. Granting, therefore, that these nebulæ and clusters of stars are formed by mutual attraction, Dr. Herschel concludes, that we may judge of their relative age by the disposition of their component parts, those being the oldest which are most compressed. He supposes, and indeed offers powerful arguments to prove, that the milky way is the nebulæ of which our sun is one of its component parts.

Dr. Herschel has also discovered other phenomena in the heavens, which he calls nebulous stars: that is, stars surrounded with a faint luminous atmosphere of large extent. Those which have been thus stiled by other astronomers, he says, ought not to have been so called, for on examination they have proved to be either mere clusters of stars plainly to be distinguished by his large telescopes, or such nebulous appearances as might be occasioned by a multitude of stars at a vast distance. The milky way consists entirely of stars; and he says, "I have been led on by degrees from the most evident congeries of stars, to other groups in which the lucid points were smaller, but still very plainly to be seen; and from them to such wherein they could but barely be suspected, until I arrived at last to spots in which no trace of a star was to be discerned. But then the gradation to these latter were by such connected steps as left no room for doubt but that all these phenomena were equally occasioned by stars variously dispersed in the immense expanse of the universe."

In the same paper is given an account of some nebulous stars, one of which is thus described: "Nov. 13, 1790. A most singular phenomenon! A star of the eighth magnitude, with a faint luminous atmosphere of a circular form, and of about 3′ in diameter. The star is perfectly in the centre, and the atmosphere is so diluted, faint, and equal throughout, that there can be no surmise of its consisting of stars, nor can there be a doubt of the evident connection between the atmosphere and the star. Another star, not much less in brightness, and in the same field of view with the above, was perfectly free from any such appearance." Hence, Dr. Herschel draws the following consequences. Granting the connection between the star and the surrounding nebulosity, if it consist of stars very remote, which gives the nebulous appearance, the central star, which is visible, must be immensely greater than the rest; or if the central star be no bigger than common, how extremely small and compressed must be those other luminous points which occasion the nebulosity. As, by the former supposition, the luminous central point must far exceed the standard of what we call a star; so in the latter, the shining matter about the centre will be too small to come under the same denomination; we therefore, either have a central body which is not a star, or a star which is involved in a shining fluid, of a nature totally unknown to us. This last opinion Dr. Herschel adopts.

Light reflected from the star could not be seen at this distance. Besides, the outward parts are nearly as bright as those near the star. Moreover, a cluster of stars will not so completely account for the milkiness, or soft tint of the light of these nebulæ, as a self luminous fluid. "What a field of novelty," says Dr. Herschel, "is here opened to our conceptions. A shining fluid, of a brightness sufficient to reach us from the regions of a star of the 8th, 9th, 10th, 11th, 12th, magnitude; and of an extent so considerable as to take up 3, 4, 5, or 6 minutes in diameter." He conjectures that this shining fluid may be composed of the light perpetually emitted from millions of stars. See Philos. Trans. vol. lxxxi. p. 1. on Nebulous Stars, properly so called.

NEBULY, or NEBULE'E, in heraldry, is when a coat is charged with several little figures, in form of words, running within one another, or when the outline of a bordure, ordinary, &c. is indented or waved.

NECESSITY, whatever is done by a necessary cause, or a power that is irresistible, in which sense it stands opposed to freedom.

NECESSITY, *philosophical*. The advocates of philosophical necessity maintain that the volitions and actions of intelligent agents are produced by causes equally determining and resistless as those which are admitted to actuate the material system of the universe. Whenever the sun shines, or the rain descends, it is impossible to conceive, that in situations precisely similar to those which immediately precede these events, the ray should be withheld, or the cloud should remain suspended in the atmosphere. The diurnal splendour, and the falling moisture, are universally allowed to be in such situations invariably and inevitably the results.

The doctrine of necessity extends to the mind what is thus obvious and uncontradicted

with respect to matter. It insists on the absolute and uncontrollable influence of motives upon the human will and conduct. It asserts, that the determinations and actions of every individual flow with unfailing precision and resistless operation, from the circumstances, motives, or states of mind by which they are preceded; and that, in the whole series of his existence, no specific feeling, thought, or act, could have been different from what it really was, these previous circumstances continuing the same. In the consideration of this subject, it is important not to confound necessity with compulsion, as the latter implies that the choice of the mind is effected with reluctance, and in consequence of the exercise of force upon inclination; whereas, whether the conclusion be formed with the full concurrence of the affections, or after a conflicting estimate, which leaves reason completely triumphant over inclination; the mind is equally impelled by some controlling energy, and equally necessitated to the determination it adopts. It is of consequence also to the illustration of the subject, fully to comprehend the meaning of the term motive, which it is to be remembered comprehends both the bias of the mind and the end in view, and includes every thing that moves or influences the mind, and excites it to a choice or determination.

The grand argument in support of philosophical necessity is derived from the relation of cause and effect. If there be any one principle in which mankind, in all their reasonings upon natural objects, have more perfectly concurred than in any other, it is the maxim, that every effect requires a cause, or in other words, that whatever begins to be, demands some antecedent circumstances tending to its production. Of the nature indeed of causation we are completely and profoundly ignorant. But from the invariable connection between certain previous and certain subsequent circumstances in the world of matter, we infer the tendency of the former to accomplish the latter, and the indispensableness of the operation of the first to the existence of the phenomena immediately following, with the same confidence as if a perfect acquaintance with the arcana of nature had unfolded to us its necessity. The association of ideas in our minds arising from the unvarying connection between certain preceding and subsequent appearances around us, becomes at length so fixed, that the observation of the first excites the undoubting expectation of the last; and where any effects produced differ from what we have been used to observe, and consequently to expect, we instantly presume that the preceding circumstances must proportionally have varied, and without an alteration in these, an alteration in the effect is pronounced impossible. Now, though we predict the acts of moral agents with less certainty, and expect them with more hesitation than mingle in our calculations on natural phenomena, this difference is attributable merely to our ignorance of the tempers, characters, and situations of those agents, to the difficulty, and frequently the impossibility, which we experience of exploring the labyrinth of the human heart, and not in the slightest degree to any doubt, that volitions will always be precisely determined by preceding states of mind, and that certain volitions will inevitably be productive of certain acts. As with regard to natural objects, we are led to consider some things the causes of others, concluding them to possess over these others a necessary and causative operation from their invariable conjunction, so particular states of mind being uniformly observed to be connected with particular determinations, are equally regarded as causes of which these determinations are the effects. The generative and irresistible influence of the motive upon the determination is inferred with as much justness and conviction as that of a certain degree of heat on liquifaction, or of cold on congelation; and a change of determination in the mind, while preceding circumstances continued the same, is considered equally impossible as that iron should swim, precisely in the same circumstances in which it previously sunk; or heat congeal exactly in the same circumstances in which it has been uniformly observed to liquify. Thus in the world of mind, as well as matter, no change of event takes place without a correspondent alteration in preceding circumstances leading to it and operating upon it. This principle lies at the foundation of all clear reasoning and legitimate conclusion. Its denial would subvert all the forms and degrees of human knowledge. All fair inference, reasonable expectation, and judicious effort, would completely cease. Ignorance and confusion, hesitation and despair, would supersede all wise arrangement, lively hope and heroic enterprise; and the noble fabric of the universe abounding in evidences of the most wise and kind design might have started into being without any intelligent cause or preceding operation. But a position thus leading to conse-

quences the most monstrous and absurd, must be totally groundless.

Every change, however minute or stupendous, however connected with unintelligent or moral nature, equally requires and possesses some cause of its existence. The steady resolves and brilliant career of virtue, as necessarily result from preceding circumstances, as the harmonious movements of the solar system; and the irregularities of vice, demand the operation of preceding impulses, equally with the wanderings of a meteor. Let any specific volition or determination be admitted at any time to exist in the mind; whence did it arise? Most certainly not uncaused; unless we are prepared by this reply to destroy all the commonly received opinions and feelings of mankind, and to admit, that though there was a period in which the order and beauty of the universe did not exist, they suddenly broke into being unconnected with any circumstances whatever tending to accomplish so glorious a result. If this volition be stated to originate in a self-determining power acting independently of motive, this self-determining power must be considered as in fact only a preceding volition, and the question therefore instead of being correctly and finally answered, is by this reply merely trifled with and evaded. Indisputably the only proper answer that can be given is, that the particular determination alluded to, necessarily originated in the views and circumstances of the mind immediately previous to its adoption. These views and circumstances resulted from other situations which preceded them, and which were the consequences of others more remote. And thus in retrograde march we travel through a long series of mental feelings and operations, finding each linked indissolubly to that by which it was preceded, and constituting part of an immense chain which soon extends beyond the reach of mortal eye, as much as it defies the control of mortal power.

Another argument for the doctrine of philosophical necessity is drawn from the divine prescience. The foreknowledge of events must inevitably preclude their contingency, for a contingent event is an event that either may or may not happen: but that which may not happen most evidently cannot be foreseen. The distinctions which have been made on this subject by the advocates of liberty, have served to exhibit the perplexity of their authors instead of contributing the slightest support to their cause. And with respect to the nature of the supreme mind, it is impossible to prove, or reasonably to believe, that the divine knowledge, infinitely superior as it unquestionably is to that of man, can embrace those things which are not the objects of knowledge, and exist so as to involve contradictions. To know that a contingent event will take place, would be to know, that an event which is decidedly and characteristically uncertain, is nevertheless certain, or in other words to know a thing to be what it is not. It is only by the expedient of limiting the divine prescience to events not dependent upon human choice, an expedient which some few have ventured to adopt, that the supporters of philosophical freedom can surmount this inconsistency; and the grossness of contradiction is thus exchanged for the flagrance of indecorum. To the believer in the absolute foreknowledge of God, the argument derived from it in support of the necessity of human actions may be considered as equally convincing with perhaps any argument, upon any subject that can be presented to the human understanding. If events are foreseen, they cannot be contingent. If they are contingent, they cannot be foreseen.

In addition to the arguments above adduced, may be added that arising from the consciousness which every man feels of being influenced by some motive in the performance of every voluntary action. If any person attempt to accomplish an act, of whatever nature, whether of importance or insignificance, without the influence of some motive to decide, he will find himself completely baffled in the enterprize, and in every instance he will be able to assign the circumstances by which he was actually influenced. He will likewise find the spirit of his exertions uniformly proportioned to the animation of his motive. Where the motive is urgent, and arising from the union of inclination and conviction, his efforts will display all the activity of enthusiasm, and all the fortitude of heroism. And in correspondence with the lessening interest of motives, his enterprizes will decline in vigour, till in the lowest instance, to adopt the language of our immortal poet, they are,

> "Sicklied o'er with the pale cast of
> thought,
> And lose the name of action."

The argument from consciousness, in-

deed, is applied by the asserters of philosophical liberty with equal confidence in support of their system; and it is insisted, that all men imagine themselves possessed of liberty of choice, and must, therefore, if the opposite doctrine be true, labour under a gross and constant delusion. The fact however unquestionably is, that the convictions of the meanest peasant, when he is enabled perfectly to comprehend the just statement of the subject, will oblige him to decide in favour of necessity. If interrogated whether, instead of going to his daily labour on a particular occasion, he could have continued at home, he will reply, that most certainly he could if he had so pleased, alluding merely to practical liberty or freedom from external controul. But when asked whether he could have remained at home with the same inducements of duty and inclination to go abroad; as soon as he fully understands the question, he will answer, that he certainly could not without changing his mind; in other words, that without some alteration in his feelings of inclination and duty, some variation in mature cause or preceding circumstances, whatever term we choose to adopt, he must inevitably have proceeded to his work.

Philosophical necessity is the only theory consistent with moral discipline. An intelligent agent is the proper subject of approbation or censure, of reward or punishment, only so far as he is determined in definite circumstances to definite volitions. If he perform a virtuous action from a pure motive, he is entitled to the approval and praise of all observers, and the remuneration which thus flows to him from general esteem, and also from the consciousness of benevolent dispositions, from the view of successful efforts, and the hope of future final reward, operates to confirm the disposition from which the act proceeded to establish a habit, and fix a character of pure beneficence in the agent, and to excite in beings similarly constituted the adoption of the same means for the attainment of the same satisfaction.

With respect likewise to censure and punishment, these are, with equal propriety, applied to every intelligent being, who, actuated by malignant motives, defames innocence, or oppresses penury, or commits any act tending to the production of mischief and misery. The application of popular blame or reproach, and the pain arising from a sense of impaired estimation, from the apprehension of private vengeance, or legal conviction, or any of those numberless modes of torture which haunt and convulse the soul of guilt, are obviously calculated to produce a change of character and conduct, to excite first thoughtfulness, and subsequently reformation in the mind of the offender, and to kindle a beacon by which those within observation will be influenced to shun a road which inevitably terminates in suffering and infamy. If any being can be supposed perfectly indifferent and independent with respect to motives, the application of all these moral means is obviously and absolutely superseded. The door is effectually closed to discipline. To attempt to operate on such a being by remonstrance or approval, by the erection of a statue, or the infliction of the torture, would be just as absurd as to thank the genial shower, or lash the tempestuous ocean; to applaud the soil for its fertility, or denounce the earthquake for its ravages.

The doctrine of necessity, moreover, tends to inspire that moral caution which is of the utmost importance towards the formation of habitual virtue. Those who rely on some indefinable self-determining power, by which they presume themselves able to act without a motive, where motives are equal, or in opposition to the strongest motive, may expose themselves to circumstances and situations in which they have before yielded to temptation without inconsistency, though certainly not without danger. The necessitarian is well aware that the same situations will ever produce the same results, that whatever be the firmness of habit, there exist temptations by which the most stable and accomplished virtue may be endangered and impaired. He will therefore sedulously avoid all unnecessary exposure, and will be particularly guarded against circumstances in which his good resolutions have already failed. For though it may be impossible for him, in a second instance, to be in a situation precisely similar to that by which he was overpowered in the first, the recollection and regret of his defeat making unquestionably some variation. This difference will by no means preclude that strong and striking similarity which must sound in his ear the trumpet of alarm, and prevent his again approaching the verge of a gulph into which he has been once miserably precipitated.

It must further be observed that the doctrine of the necessity of human actions

tends strongly to excite and cherish the benevolent affections. It represents human agents as merely instrumental to the views and schemes of Deity, under whose hands all intelligent creatures resemble the toys upon the chequered table, directed to his purpose, and impelled by his energy. A consideration this, admirably calculated to substitute compassion for resentment, to check the thirst of vengeance, and the severity of punishment. The propriety indeed and indispensableness of exhibiting to the mind motives or applications of a painful character, are admitted to be more clearly perceivable upon this system than on any other; and in truth are, only upon this system, perceivable at all. Authority must rebuke, law must menace, tribunals must sentence.

The accomplishment of individual reformation, and the prevention of public corruption, must be attempted by the means best adapted to these objects, and these means, from the constitution of human nature, include a certain portion of physical evil; but this is admitted, on the doctrine of necessity, only as remedial, or preventive of greater evil. Punishment upon this system proceeds not from revenge, but from benevolence. The offender is considered as having been urged to the act of guilt by circumstances controlling his will with the most rigid and irresistible dominion; as impelled not more by voluntary determination than by necessitating motive. He is considered as requiring, indeed, inflictions of a description highly impressive and penal, to enable him to break the bands of vicious habits; but the indispensableness of these inflictions is perceived with extreme regret, and yielded to with extreme reluctance. The persecutor is even more compassionated than his victim, and the tear of pity accompanies the lash of punishment.

It has been urged, that the doctrine of necessity tends to discourage exertion as useless, and to produce a total stagnation and torpor of the soul, since every thought and act of every individual being determined by necessary influences, and regulated by eternal laws. These can no more be counteracted by him, than he can pluck the moon from her orbit; or comprehend the ocean in a span. Whatever be the pressure of this difficulty, it is by no means peculiar to the doctrine in question, but applies with equal force to all who maintain the prescience of the Supreme Being, and who are, in fact, nearly all that do not deny his existence.

Foreknowledge unquestionably includes the certainty of those events which are foreknown, yet the advocates of liberty and prescience by no means regard this absolute certainty as precluding the employment of means. But necessity is merely another word for certainty, and the remonstrances and exhortations, the deliberations and efforts, which are admitted to be usefully instrumental with respect to events decidedly foreknown, must be allowed equally applicable with regard to such as are fixed by the eternal series of necessary causation and production. The events in both cases are equally certain, and, on that account merely, equally inevitable, and equally necessitated. In reality, whatever be the certainty or necessity of future events, the ignorance of man respecting them will always operate upon him as if they were actually uncertain or contingent. The conviction felt by every one that the period and circumstances of his dissolution are perfectly known to God, and consequently unalterable by prayers or efforts, does not diminish his exertions for the preservation of his life; and the farmer cultivates his ground with equal attention and assiduity, though, he knows, it is clearly foreseen by God whether the reaper shall gather a crop of grain or mildew. If ends are certain and necessary, so likewise are means. Those who neglect the latter, are precluded from the former. The seed deposited in the ground may not always mature into the golden harvest, but unless the seed be deposited no harvest whatever can appear. The regular application of food and air will not always preserve the human frame in vitality and vigour; but without air and food its strength and life must inevitably perish.

Voluntary action is an essential link in the chain of causes. The whole course of moral nature ascertains its necessity to the accomplishment of various objects of human wishes, and the man who, possessing ardent desires for any particular object, declines the employment of those efforts without which it must be miraculous or impossible that he should obtain it, must be considered as exhibiting an instance of something worse than absurd reasoning, in proportion as madness is more pitiable than absurdity.

Finally, upon the principles of necessity, God is undoubtedly the author of evil: a

statement which, to the minds of some, may carry the appearance of the most irreverent, and even impious imputation, and excite against the system, which not only thus maintains, but avows it, a repulsion amounting to antipathy. The question, however, relates to truth and not to feeling, and those who pursue the former with that ardent attachment and eager research which it merits, will endeavour to divest themselves as much as possible of prejudice and prepossession, and strive to attain that point of elevation to which the fogs of passion never ascend, and at which the mental eye can range at once with clearness and comprehension. Every act and volition of intelligent creatures is the immediate effect of necessitating circumstances, originating in other circumstances equally necessitated, and which, through a long series of operation and result, must be considered as depending on that situation into which, independently of their own consent or control, they were at first introduced by their Creator. Every reflection, determination and deed, therefore, however tainted by vice, or exalted by virtue, must indisputably, upon this statement, flow from the divine appointment and energy. But to those who admit the prescience of the Deity, who do not, in order to support an hypothesis, proceed so far as to divest the Supreme Being of that foreknowledge of events, without which confusion and disappointment must apparently result to the divine mind, from occurrences neither appointed nor expected, the difficulty under consideration is precisely the same. All such must admit, that he who sees the end from the beginning, placed all human beings originally in situations, the most minute results of which were fully comprehended and foreknown by him. Notwithstanding his precise comprehension of all the consequences which must flow from their origination in such circumstances, in such circumstances they were actually placed, and foreseeing that natural and moral evil would be the certain effects of his own voluntary act in man's creation, he must not only have permitted, but designed these effects. The prescience of a mere observer would by no means necessarily imply any intention than the event foreseen should be accomplished, or any thing more indeed than the absolute certainty of the event itself. But the prescience possessed by an agent of all the circumstances that will arise from any particular act, inevitably includes in his purpose to accomplish that act, a purpose to produce these circumstances, and renders him as much the author of the inevitable consequences as of the previous act; and if evil therefore were foreknown to be the necessary result of man's formation, the existence of evil, and the formation of man, are equally attributable to the divine appointment.

But it is time to observe, that when God is stated to be the author of evil, it is by no means meant to be understood that he approves of it in itself, that he is pleased with the infliction of pain, and like an omnipotent dæmon delights in scattering darts and firebrands, terror and agony, through a trembling and prostrate universe. The meaning is, that in the system of creation most worthy of the perfections of the Deity, because eventually most conducive to the happiness of his offspring, some portion of natural and moral evil was absolutely unavoidable, and that his object is to combine as much as possible the least evil with the greatest good. In the accomplishment of this sublime object particular beings may be exposed to a very considerable share of suffering; but this is no imputation upon his justice or benevolence. He possesses a sovereign right over the creatures he has formed, and the utmost demand that can be made by any beings upon his equity is, that in the amount of their existence, misery should not predominate over happiness. But whatever may be the case with certain individuals, there is reason to presume and believe, that with respect to the intelligent and moral creation as a whole, suffering will at length nearly disappear in the grand mass and display of enjoyment. That union of wisdom, power, and goodness, which it appears inevitable to ascribe to God, seems to guarantee an issue of his schemes and government, thus honourable to his nature, and thus happy for his offspring. With resignation therefore, and even transport, we may contemplate this glorious Being, sitting at the helm of the universe, managing all affairs, and administering the whole series of events, guiding all to his magnificent purposes, guided himself by consummate knowledge and inexhaustible kindness, impelling every act, reflection and feeling of his intelligent creation, himself impelled by his own boundless views and eternal benevolence. For the arguments on the other side of the question, viz. the "Liberty of the Will." See Will, *liberty of*.

NECK, is that slender part situated between the head and the trunk of the body. See ANATOMY.

NECTARINE. See PERSICA.

NECTARIUM, in botany, according to Linnæus, is a part of the corolla, appropriated for containing honey, that oozes from the plant, and is the principal food of bees and other insects.

NECTRIS, in botany, a genus of the Hexandria Digynia class and order. Natural order of Tripetaloideæ. Junci, Jussieu. Essential character: calyx one-leafed, six-parted, coloured; corolla none; styles permanent; capsules two, superior, ovate, one-celled, many-seeded. There is but one species, *viz.* N. aquatica. This plant grows in ponds, lakes, and rivers, that have not a rapid current, pushing out long, knotted, fistulous stems, with a pair of leaves at each joint. The flowers come out from the axils of the leaves, on a long peduncle; the three outer leaves of the calyx are green on the outside and yellow within. It is a native of Guiana and the island of Cayenne.

NECYDALIS, in natural history, a genus of insects of the order Coleoptera. Antennæ setaceous or filiform; four feelers, filiform; shells less than the wings, and either narrower or shorter than the abdomen; tail simple. There are about forty species, in two sections. A. Antennæ setaceous; shells shorter than the wings and abdomen. B. Antennæ filiform; shells subulate, as long as the body. N. humeralis, is found in this country: shells subulate, black, yellow at the base, without lines; body and legs black.

NE *exeat Regno*, is a writ to restrain a person from going out of the kingdom without the King's licence. Within the realm the King may command the attendance and service of all his liegemen; but he cannot send any man out of the realm, not even upon the public service, except seamen and soldiers, the nature of whose employment necessarily implies an exception. This writ is now mostly used where a suit is commenced in the Court of Chancery against a man, and he, intending to defeat the other of his just demand, or to avoid the justice and equity of the court, is about to go beyond sea. If the writ be granted on behalf of a subject, and the party taken, he either gives security by bond in such sum as is demanded, or he satisfies the court by answering (where the answer is not already in), or by affidavit, that he intends not to go out of the realm, and gives such reasonable security as the court directs, and then he is discharged.

NEEDLE, a very common little instrument or utensil, made of steel, pointed at one end, and pierced at the other, used in sewing, embroidery, tapestry, &c.

Needles make a very considerable article in commerce, though there is scarcely any commodity cheaper, the consumption of them being almost incredible. The sizes are from number 1, the largest, to number 25, the smallest. In the manufacture of needles, German and Hungarian steel are of most repute. In the making them, the first thing is to pass the steel through a coal fire, and under a hammer, to bring it out of its square figure into a cylindrical one. This done it is drawn through a large hole of a wire-drawing-iron, and returned into the fire, and drawn through a second hole of the iron, smaller than the first, and thus successively, from hole to hole till it has acquired the degree of fineness required for that species of needles, observing every time it is to be drawn that it be greased over with lard, to render it more manageable. The steel thus reduced to a fine wire, is cut in pieces of the length of the needles intended. These pieces are flatted at one end on the anvil, in order to form the head and eye: they are then put into the fire to soften them further, and thence taken out and pierced at each extreme of the flat part on the anvil, by force of a puncheon of well-tempered steel, and laid on a leaden block to bring out, with another puncheon, the little piece of steel remaining in the eye. The corners are then filed off the square of the heads, and a little cavity filed on each side of the flat of the head: this done, the point is formed with a file, and the whole filed over: they are then laid to heat red hot on a long flat narrow iron, crooked at one end, in a charcoal fire, and when taken out thence, are thrown into a bason of cold water to harden. On this operation a good deal depends: too much heat burns them, and too little leaves them soft: the medium is learned by experience. When they are thus hardened, they are laid in an iron-shovel on a fire, more or less brisk in proportion to the thickness of the needles; taking care to move them from time to time. This serves to temper them, and take off their brittleness: great care here too must be taken of the degree of heat. They are then straitened one after another with the hammer, the coldness of the water used in hardening them having

twisted the greatest part of them. The next process is the polishing them. To do this they take twelve or fifteen thousand needles, and range them in little heaps against each other on a piece of new buckram sprinkled with emery-dust. The needles thus disposed, emery-dust is thrown over them, which is again sprinkled with oil of olives; at last the whole is made up into a roll, well bound at both ends. This roll is then laid on a polishing-table, and over it a thick plank loaden with stone, which two men work backwards and forwards a day and a half, or two days, successively; by which means the roll thus continually agitated by the weight and motion of the plank over it, the needles withinside being rubbed against each other with oil and emery, are insensibly polished. After polishing they are taken out, and the filth washed off them with hot water and soap: they are then wiped in hot bran, a little moistened, placed with the needles in a round box, suspended in the air by a cord, which is kept stirring till the bran and needles be dry. The needles thus wiped in two or three different brans, are taken out and put in wooden vessels, to have the good separated from those whose points or eyes have been broke either in polishing or wiping: the points are then all turned the same way, and smoothed with an emery stone turned with a wheel. This operation finishes them, and there remains nothing but to make them into packets of two hundred and fifty each.

Needle, *magnetical*, in navigation, a needle touched with a loadstone, and sustained on a pivot or centre: on which playing at liberty, it directs itself to certain points in or under the horizon; whence the magnetical needle is of two kinds, *viz.* horizontal and inclinatory.

Horizontal needles are those equally balanced on each side the pivot that sustains them: and which, playing horizontally with their two extremes, point out the north and south points of the horizon.

In the construction of the horizontal needle a piece of pure steel is provided, of a length not exceeding six inches, lest its weight impede its volubility, very thin, to take its verticity the better, and not pierced with any holes, or the like, for ornament sake, which prevent the equable diffusion of the magnetic virtue. A perforation is then made in the middle of its length, and a brass-cap or head soldered on, whose inner cavity is conical, so as to play freely on a style or pivot headed with a fine steel-point. The north point of the needle in our hemisphere is made a little lighter than the southern; the touch always destroying the balance, if well adjusted before, and rendering the north end heavier than the south and thus occasioning the needle to dip.

The needle is not found to point precisely to the north except in very few places, but deviates from it more or less in different places, and that too at different times, which deviation is called its declination or variation from the meridian.

Inclinatory or dipping-needle, a magnetical needle, so hung, as that, instead of playing horizontally and pointing out north and south, one end dips or inclines to the horizon, and the other points to a certain degree of elevation above it. Or a dipping-needle may be defined to be a long straight piece of steel, every way poised on its centre, and afterwards touched with a loadstone, but so contrived as not to play on the point of a pin, as does the common horizontal needle, but to swing in a vertical plane, about an axis parallel to the horizon; and this to discover the exact tendency of the power of magnetism. See Magnetism.

To find the longitude or latitude by the dipping-needle. If the lines of equal dip below the horizon be drawn on maps or sea charts from good observations, it will be easy, from the longitude known, to find the latitude, and from the latitude known to find the longitude, either at sea or land. Suppose, for example, you were travelling or sailing along the meridian of London, and found the angle of dip with a needle of one foot to be 75°, the chart will show that this meridian and the line of dip meet in the latitude 53° 11′, which is, therefore, the latitude sought. See Latitude. Or suppose you were travelling or sailing along the parallel of London, that is, in 51° 32′ north latitude, and you find the angle of dip to be 74°. The parallel and the line of this dip will meet in the map in 1° 46′ of east longitude from London, which is therefore the longitude sought.

Needle *stone*, in mineralogy, a species of the Zeolite family, found in Iceland and Britanny. Its common colour is a yellowish white. It occurs massive, and crystallized in rectangular four-sided acicular prisms, which are generally aggregated. It is distinguished from the radiated zeolite, by being harder and more brittle, by its lustre being greater, and of the vitreous kind.

NEGATIVE, in general, something that implies a negation. Thus we say, negative

quantities, negative signs, negative powers, &c. See ALGEBRA.

Our words and idea, says Dr. Watts, are so unhappily linked together, that we can never know which are positive, which negative ideas, by the words that express them: for some positive terms denote a negative idea, as *dead*; and there are both positive and negative terms invented to signify the same and contrary ideas, as *unhappy* and *miserable*. To this may also be added, that some words, which are negative in the original language, seem positive in English, as *abyss*. The way, therefore, to know whether any idea be negative or not, is to consider whether it primarily implies the absence of any positive being, or mode of being; if so, then it is a negative idea, otherwise a positive one.

NEGATIVE *sign*, the sign of subtraction, or that which denotes something in defect. The use of the negative sign in algebra is attended with several consequences that at first sight are admitted with some difficulty, and has sometimes given occasion to notions that seem to have no real foundation. This sign implies, that the real value of the quantity represented by the letter to which it is prefixed, is to be subtracted; and it serves, with the positive sign, to keep in view what elements or parts enter into the composition of quantities, and in what manner, whether as increments or decrements, that is, whether by addition or subtraction, which is of the greatest use in this art. Hence it serves to express a quantity of an opposite quality to a positive, such as a line in a contrary position, a motion with opposite direction, or a centrifugal force in opposition to gravity; and thus it often saves the trouble of distinguishing, and demonstrating separately, the various cases of proportions, and preserves their analogy in view. But as the proportions of lines depend on their magnitude only, without regard to their position; and motions and forces are said to be equal or unequal, in any given ratio, without regard to their directions: and in general the proportion of quantities relates to their magnitude only, without determining whether they are to be considered as increments or decrements; so there is no ground to imagine any other proportion of $+a$ and $-b$, than that of the real magnitudes of the quantities represented by a and b, whether these quantities are, in any particular case, to be added or subtracted.

NEGRO, a name given to a variety of the human species, who are entirely black, and are found in the torrid zone, especially in that part of Africa which lies between the tropics. See MAN; SLAVE; SLAVE *trade*.

NEPA, in natural history, *water-scorpion*, a genus of insects of the order Hemiptera. Snout inflected; antennæ short; wings four, folding cross-wise, coriaceous on the upper part; fore legs cheliform; the other four formed for walking. There are fourteen species in three divisions, *viz*. A. Antennæ palmate, without a lip. B. Antennæ palmate; lip short, widely emarginate. C. Lip projecting, rounded. N. linearis, described by Mr. Donovan, has a tail ending in two bristles, as long as the body: thorax of one colour; fore-shanks with a spine in the middle. The body is brown, cylindrical; abdomen red; the eggs are oblong, and armed at one end with two bristles, and are found inclosed in the culm or stem of rushes, with hairs standing out.

NEPENTHES, in botany, a genus of the Dioecia Syngenesia class and order. Essential character: calyx four-parted; corolla none: male, filament one, with many anthers, connected into a peltate head: female, style none; stigma large, peltate four-lobed; capsule four-celled, with many arilled seeds. There is but one species, *viz*. N. distillatoria, a native of the island of Ceylon.

The nepenthes may justly be classed among the most singular productions of the vegetable world. The plant has always excited the admiration of those who have examined its structure, with a view to the contrivance which is so strikingly exhibited in the formation of its leaves. The nepenthes is a native of India: it is an herbaceous plant, with thick roots and a simple stem, crowned with flowers disposed in bunches. The leaves are alternate, partly embracing the stem at their base, and terminated by tendrils, each of which supports a deep, membranous urn, of an oblong shape, and closed by a little valve like the lid of a box. This appendage to the leaf appears to be as designed and studied a piece of mechanism as any thing we can meet with in nature's more complicated productions. The leaf, as we have already said, is terminated by a deep oblong urn: this, in general, is filled with a sweet limpid water. In the morning, the lid is closed, but it opens during the heat of the day, and a portion of the water evaporates; this is replenished in the night, and each morning the vessel is full, and the lid shut. The

plant grows in a climate where the parched traveller is frequently in want of refreshment, and gladly avails himself of the water which this vegetable affords, each urn containing about the measure of half a wine-glass. The use of this plant is too evident to need any comment. It is one of the many instances in nature of the bounty of Providence, who has filled the urns of the nepenthes with a treasure, of all others the most refreshing to the inhabitants of hot climates.

NEPER or NAPIER (JOHN), in biography, Baron of Marchiston, in Scotland, inventor of the logarithms, was the eldest son of Sir Archibald Napier, of Marchiston, and born in the year 1550. Having given early indications of great natural parts, his father was careful to have them cultivated by a liberal education. After going through the ordinary course of education at the university of St. Andrew's, he made the tour of France, Italy, and Germany. On his return to his native country, his literature and other fine accomplishments soon rendered him conspicuous; he, however, retired from the world to pursue literary researches, in which he made an uncommon progress, as appears by the several useful discoveries with which he afterwards favoured mankind. He chiefly applied himself to the study of mathematics, without, however, neglecting that of the Scriptures; in both of which he discovered a very extensive knowledge, and profound penetration. His "Essay upon the Book of the Apocalypse" indicates the most acute investigation; though time has discovered, that his calculations concerning particular events had proceeded from fallacious data. But what has chiefly rendered his name famous was his great and fortunate discovery of logarithms in trigonometry, by which the ease and expedition in calculation have so wonderfully assisted the science of astronomy, and the arts of practical geometry and navigation. Napier, having a great attachment to astronomy and spherical trigonometry, had occasion to make many numeral calculations of such triangles, with sines, tangents, &c.; and these being expressed in large numbers, they hence occasioned a great deal of labour and trouble: to spare themselves part of this trouble, Napier, and other authors about his time, set themselves to find out certain short modes of calculation, as is evident from many of their writings. To this necessity, and these endeavours it is, that we owe several ingenious contrivances, particularly the computation by Napier's rods, and several other curious and short methods that are given in his "Rabdologia;" and, at length, after trials of many other means, the most complete one of logarithms, in the actual construction of a large table of numbers in arithmetical progression, adapted to a set of as many others in geometrical progression. The property of such numbers had been long known, viz. that the addition of the former answered to the multiplication of the latter, &c.; but it wanted the necessity of such very troublesome calculations as those above mentioned, joined to an ardent disposition, to realize the use of that property. Perhaps, also, this disposition was urged into action by certain attempts of this kind, which, it seems, were made elsewhere; such as the following, related by Wood, in his "Athenæ Oxonienses," under the article Briggs, on the authority of Oughtred and Wingate, viz. "That one Dr. Craig, a Scotchman, coming out of Denmark into his own country, called upon John Neper, baron of Merchiston, near Edinburgh, and told him, among other discourses, of a new invention in Denmark, (by Longomontanus, as 'tis said), to save the tedious multiplication and division in astronomical calculations. Neper, being solicitous to know further of him concerning this matter, he could give no other account of it, than that it was by proportionable numbers; which hint Neper taking, he desired him, at his return, to call upon him again: Craig, after some weeks had passed, did so, and Neper then showed him a rude draught of that he called Canon Mirabilis Logarithmorum; which draught, with some alterations, he printed in 1614; it came forthwith into the hands of our author, Briggs, and into those of William Oughtred, from whom the relation of this matter came."

Whatever might be the inducement, however, Napier published his invention in 1614, under the title of "Logarithmorum Canonis Descriptio," &c. containing the construction and canon of his logarithms, which are those of the kind that is called hyperbolic. This work coming presently to the hands of Mr. Briggs, then Professor of Geometry at Gresham College, in London, he immediately gave it the greatest encouragement, teaching the nature of the logarithms in his public lectures, and at the same time recommending a change in the scale of them, by which they might be ad-

vantageously altered to the kind which he afterwards computed himself, which are thence called Brigg's logarithms, and are those now in common use. Mr. Briggs also presently wrote to Lord Napier upon this proposed change, and made journeys to Scotland the two following years, to visit Napier, and consult him about that alteration, before he set about making it. Briggs, in a letter to Archbishop Usher, March 10th, 1615, writes thus: "Napier, Lord of Merchiston, hath set my head and hands at work with his new and admirable logarithms. I hope to see him this summer, if it please God; for I never saw a book which pleased me better, and made me more wonder." Briggs accordingly made him the visit, and staid a month with him.

The following passage from the life of Lilly the astrologer, contains a curious account of the meeting of those two illustrious men. "I will acquaint you (says Lilly) with one memorable story, related unto me by John Marr, an excellent mathematician and geometrician, whom I conceive you remember. He was servant to King James and Charles I. At first when the Lord Napier, or Merchiston, made public his logarithms, Mr. Briggs, then reader of the astronomy lectures at Gresham College in London, was so surprised with admiration of them, that he could have no quietness in himself until he had seen that noble person the Lord Merchiston, whose only invention they were: he acquaints John Marr herewith, who went into Scotland before Mr. Briggs, purposely to be there when these two so learned persons should meet. Mr. Briggs appointed a certain day when to meet at Edinburgh; but failing thereof, the Lord Napier was doubtful he would not come. It happened one day, as John Marr and the Lord Napier were speaking of Mr. Briggs: 'Ah, John, (said Merchiston) Mr. Briggs will not now come.' At the very instant one knocks at the gate; John Marr hastened down, and it proved John Briggs, to his great contentment. He brings Mr. Briggs up into my Lord's chamber, where almost one quarter of an hour was spent each beholding the other almost with admiration before one word was spoke. At last Mr. Briggs began: 'My Lord, I have undertaken this long journey purposely to see your person, and to know by what engine of wit or ingenuity you came first to think of this most excellent help into astronomy, viz. the logarithms: but, my Lord, being by you found out, I wonder nobody else found it out before, when now known it is so easy.' He was nobly entertained by the Lord Napier; and every summer after that, during the Lord's being alive, this venerable man, Mr. Briggs, went purposely into Scotland to visit him."

Napier made also considerable improvements in spherical trigonometry, &c. particularly by his "Catholic, or Universal Rule," being a general theorem by which he resolves all the cases of right-angled spherical triangles, in a manner very simple and easy to be remembered; namely, by what he calls the five circular parts. His construction of logarithms too, beside the labour of them, manifests the greatest ingenuity. Kepler dedicated his "Ephemerides" to Napier, which were published in the year 1617; and it appears from many passages in his letter, about this time, that he accounted Napier to be the greatest man of his age, in the particular department to which he applied his abilities.

The last literary exertion of this eminent person, was the publication of his "Rabdology and Promptuary," in the year 1617, soon after which he died at Merchiston, the 3d of April, in the same year, in the sixty-eighth year of his age. The list of his works is as follows:

1. A Plain Discovery of the Revelation of St. John; 1593.

2. Logarithmorum Canonis Descriptio; 1614.

3. Mirifici Logarithmorum Canonis Constructio; et eorum ad Naturales ipsorum numeros habitudines; una cum appendice, de alia eaque præstantiore Logarithmorum specie, condenda. Quibus accessere propositiones ad triangula sphærica faciliore calculo resolvenda. Una cum Annotationibus aliquot doctissimi D. Henrici Briggii in eas, et memoratam appendicem. Published by the Author's son, in 1619.

4. Rabdologia, seu Numerationis per Virgulas, libri duo, 1617. This contains the description and use of the bones or rods; with several other short and ingenious modes of calculation.

5. His Letter to Anthony Bacon, (the original of which is in the Archbishop's Library at Lambeth), intitled Secret Inventions, profitable and necessary in these days for the defence of this island, and withstanding strangers, enemies to God's truth and religion; dated June 2, 1596.

NEPER's *rods*, or *bones*, an instrument in-

vented by the above-named person, whereby the multiplication and division of large numbers are much facilitated.

As to the Construction of Neper's Rods: suppose the common table of multiplication to be made upon a plate of metal, ivory, or paste-board, and then conceive the several columns (standing downwards from the digits on the head) to be cut asunder; and these are what we call Neper's rods for multiplication. But then there must be a good number of each; for as many times as any figure is in the multiplicand, so many rods of that species (*i. e.* with that figure on the top of it) must we have; though six rods of each species will be sufficient for any example in common affairs: there must also be as many rods of 0's.

But before we explain the way of using these rods, there is another thing to be known, viz. that the figures on every rod are written in an order different from that in the table. Thus, the little square space, or division, in which the several products of every column are written, is divided into two parts by a line across, from the upper angle on the right to the lower on the left; and if the product is a digit, it is set in the lower division; if it has two places, the first is set in the lower, and the second in the upper division; but the spaces on the top are not divided; also there is a rod of digits, not divided, which is called the index rod, and of this we need but one single rod.

Multiplication by Neper's Rods. First lay down the index rod: then on the right of it set a rod, whose top is the figure in the highest place of the multiplicand: next to this again, set the rod whose top is the next figure of the multiplicand; and so on in order, to the first figure. Then is your multiplicand tabulated for all the nine digits; for in the same line of squares standing against every figure of the index-rod, you have the product of that figure, and therefore you have no more to do but to transfer the products and sum them. But in taking out these products from the rods, the order in which the figures stand obliges you to a very easy and small addition: thus, begin to take out the figure in the lower part, or unit's place, of the square of the first rod on the right: add the figure in the upper part of this rod to that in the lower part of the next, and so on, which may be done as fast as you can look on them. To make this practice as clear as possible, take the following example.

Example. To multiply 4,768 by 385.

Having set the rods together for the number 4,768, against 5 in the index, I find this number, by adding according to the rule 23,840
Against 8, this number.............. 38,144
Against 3, this number..............14,304

Total product 1,835,680

To make the use of the rods yet more regular and easy; they are kept in a flat, square box, whose breadth is that of ten rods, and the length that of one rod, as thick as to hold six (or as many as you please) the capacity of the box being divided into ten cells, for the different species of rods. When the rods are put up in the box, (each species in its own cell distinguished by the first figure of the rod set before it on the face of the box near the top) as much of every rod stands without the box as shews the first figure of that rod; also upon one of the flat sides without and near the edge, upon the left hand, the index-rod is fixed: and along the foot there is a small ledge, so that the rods, when applied, are laid upon this side, and supported by the ledge, which makes the practice very easy; but in case the multiplicand should have more than nine places, that upper face of the box may be made broader. Some make the rods with four different faces, and figures on each for different purposes.

Division by Neper's Rods. First tabulate your divisor; then you have it multiplied by all the digits, out of which you may choose such convenient divisors as will be next less to the figures in the dividend, and write the index answering in the quotient, and so continually, till the work is done. Thus 2,179,788, divided by 6,123, gives in the quotient 356.

Having tabulated the divisor, 6,123, you see that 6,123 cannot be had in 2,179; therefore take five places, and on the rods find a number that is equal, or next less to 21,797, which is 18,369; that is, three times the divisor, wherefore set 3 in the quotient, and subtract 18,369 from the figures above, and there will remain 3,428; to which add 8, the next figure of the dividend, and seek again on the rods for it, or the next less, which you will find to be five times; therefore set 5 in the quotient, and subtract 30615 from 34,228, and there will remain 3,673, to which add 8, the last figure in the dividend, and finding it to be just six times the divisor, set 6 in the quotient.

6123)2179788(356
18369
34288
30615
36738
36738
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NEPETA, in botany, *catmint*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: corolla, lower lip with an intermediate segment, crenate; throat reflex at the edge; stamina approximating. There are twenty species, among which is the N. cataria, common catmint; it has a perennial root, and many branching stalks, about two feet in height, upright, pubescent; leaves of a velvet-like softness, wrinkled, ash-coloured; spikes, composed of interrupted whorls, terminate the stem; flowers sub-sessile; calyx downy, with green ribs; corolla white; the whole plant has a strong scent, between mint and pennyroyal; is is called catmint, because cats are very fond of it, especially when it is withered, when they will roll themselves on it, tear it to pieces, and chew it with pleasure. It is a native of most parts of Europe, on banks and hedges, chiefly in a calcareous soil, flowering from July to September.

NEPHELIUM, in botany, a genus of the Monoecia Pentandria class and order. Natural order of Tricoccæ. Corymbiferæ, Jussieu. Essential character: male, calyx five-toothed; corolla none: female, calyx four-cleft; corolla none; germs two, with two styles to each; drupes two, muricated, one-seeded. There is but one species, *viz.* N. lappaceum, a native of the East Indies.

NEPHRITE, in mineralogy, a species of the Talc genus; it is also called *jade*, or *jade-stone*. It was formerly celebrated for its medical virtues. It is of a dark leek-green colour, verging to blue. It occurs massive in detached rounded pieces. The smooth external surface is glimmering with an oily lustre, internally it is dull, except when mixed with fibres of asbestos and scales talc. The specific gravity is about 3. There are two sub-species: the common, and axe-stone: the former is somewhat brittle, takes a good polish, and is cut into handles for knives, &c., the latter is made into hatchets by the natives of New Zealand. Nephrite is found in Egypt, China, America, the islands in the Pacific Ocean, and in the Siberian mountains, sometimes adhering to rocks, and sometimes in detached round pieces. It is highly prized by the Hindoos and Chinese, by whom it is made into talismans and idols, and by the Turks, who form it into sword and dagger handles.

NEPHRITIC, something that relates to the kidneys.

NEREIS, in natural history, a genus of the Vermes Mollusca class and order. Body long, creeping, with numerous lateral peduncles or feet on each side; feelers simple, two or four eyes. There are about thirty species, in separate divisions, *viz.* A. Mouth furnished with a claw or forceps. B. Mouth furnished with a proboscis. C. Mouth furnished with a tube. N. noctiluca, body blue-green, with twenty-three segments, hardly visible to the naked eye. These are found in most seas, and are the animals that frequently illuminate the water, making it appear as if on fire. They are extremely minute, pellucid, and highly phosphorus, giving an uncommonly lucid splendor to the waves in the evening. By their extreme numbers and smallness, they easily elude observation, but may be detected by passing a small quantity of water through blotting paper.

NERITA, in natural history, a genus of the Vermes Testacea class and order. Animal a limax; shell univalve, spiral, gibbous, flattish at bottom; aperture semi-orbicular or semi-lunar; pillar-lip transversely truncate, flattish. There are nearly eighty species, divided into distinct sections, *viz.* A. Umbilicate. B. Imperforate, with the lips toothless. C. Imperforate, with the lips toothed. N. fluviatilis, with only two spires; brittle, dusky, marked with white spots. It is not half the size of a pea, and inhabits rivers and standing waters.

NERIUM, in botany, *oleander*, a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Apocineæ, Jussieu. Essential character: contorted; corolla with the tube terminated by a lacerated crown; follicles two, erect. There are nine species: these are beautiful evergreen shrubs or trees, upright and branching; leaves opposite, or by threes in a sort of whorl; flowers in clusters, or corymbs, from the ends of the stem and branches. They are chiefly natives of the East Indies.

NERTERA, in botany, a genus of the Tetrandria Digynia class and order. Essential character: corolla funnel-form, four-

cleft, superior; berry two-celled; seeds solitary. There is but one species, viz. N. depressa, found in New Granada.

NERVES, are cylindrical whitish parts, usually fibrose in their structure; or composed of clusters of filaments, arising from the brain, or rather from its medulla oblongata within the skull, and from the spinal marrow, and running from thence to every part of the body. See ANATOMY.

NET, a device for catching fish and fowl. The taking fowls by nets is the readiest and most advantageous of all others where numbers are to be taken. The making the nets is very easy, and what every true sportsman ought to be able to do for himself. All the necessary tools are wooden needles, of which there should be several of different sizes, some round and others flat: a pair of round-pointed and flat scissars, and a wheel to wind off the thread. The packthread is to be of different strength and thickness, according to the sort of birds to be taken; and the general size of the meshes, if not for very small birds, is two inches from point to point. The nets should neither be made too deep nor too long, for they are then difficult to manage; and they must be verged on each side with twisted thread. The natural colour of the thread is too bright and pale, and is therefore in many cases to be altered. The most usual colour is the russet, which is to be obtained by plunging the net after it is made into a tanner's pit, and letting it lie there till it be sufficiently tinged: this is of a double service to the net, since it preserves the thread as well as alters the colour. The green colour is given by chopping some green wheat and boiling it in water, and then soaking the net in this green tincture. The yellow colour is given in the same manner with the decoction of celandine, which gives a pale straw colour, which is the colour of stubble in the harvest time. The brown nets are to be used on ploughed lands, the green on grass grounds, and the yellow on stubble lands.

NETTINGS, in a ship, a sort of grates made of small ropes, seized together with rope-yarn or twine, and fixed on the quarters and in the tops; they are sometimes stretched upon the ledges from the waste-trees to the roof-trees, from the top of the forecastle to the poop, and sometimes are laid in the waste of a ship to serve instead of gratings.

NETTLE. See URTICA.

NEUMANN (GASPAR, M. D.) in biography, an eminent chemist, was born in 1683, at Zullichau, in the duchy of Crossen, in Brandenburg, of which place his father was a burgher and apothecary. He was brought up to his father's profession, and in 1705 went to Berlin, where he engaged in the service of the King of Prussia. After having accompanied him in his journeys for some years, he was allowed to study at the university of Halle, and was then sent at the King's expence to travel for improvement in chemical knowledge. In 1711 he visited the German mines, and thence passed into Holland, where he attended the lectures of the illustrious Boerhaave. Thence he went to England, where the news of the death of his sovereign, in 1713, somewhat deranged his plans. He again visited Holland, and in 1716 accompanied George I. King of England, to Hanover. On repairing to Berlin, he obtained the friendship of Stahl, physician to Frederick-William, who procured an order for him to resume his travels at the expence of the court. He visited France and Italy, every where increasing his stock of scientific knowledge, and forming connections with men of eminence. Upon his return to Berlin he was appointed court-apothecary; and when the king, in 1723, established a college of medicine and surgery in his capital, Neumann was nominated to the chair of chemistry. He received the degree of M. D. from Halle in 1727, and in that year travelled through Silesia and Moravia to Vienna, returning by Bohemia and the mining country of Saxony. His reputation now extended to the different countries of Europe, and he was elected a member of the Royal Society of London, of the Imperial Academy Naturæ Curiosorum, and of the Institute of Bologna. In 1734 he made a tour to the New Marche and Pomerania, where he discovered the true origin of Osteocolla. He became dean of the college of Berlin in 1736, and died in that city in 1737. The works published by Dr. Neumann in his life-time, consist chiefly of dissertations in the Latin language, inserted in the "Philosophical Transactions of London," the "Ephemerides Acad. Naturæ Curiosorum," and the "Miscellanea Berolinensia, and of others in the German language published separately. After his death two different copies of his "Chemical Lectures" were given to the public; one, in two editions, at Berlin and Dresden, from notes taken by one of his pupils, intermixed with compilations from different authors; the other by the book-

[illegible] From this Dr. Lewis has made an excellent English translation, in two volumes, quarto, not abridged, but better methodized, and enriched with notes. "Neumann's Lectures," says Dr. Lewis, "are a valuable treasure of chemical knowledge. The author, biassed by no theory, and attached to no opinions, has enquired by experiment into the properties and uses of the most considerable natural and artificial productions, and the preparation of the principal commodities which depend on chemistry: and seems to have candidly, and without reserve, communicated what he discovered." Such a work must retain its value, notwithstanding the great modern changes in chemical theory.

NEURADA, in botany, a genus of the Decandria Decagynia class and order. Natural order of Succulentæ. Rosaceæ, Jussieu. Essential character: calyx five-parted; petals five, capsule inferior, ten-celled, ten-seeded, prickly. There is but one species; viz. N. procumbens, an annual plant; native of Egypt, Arabia, and Numidia.

NEUROPTERA, in natural history, the name of the fourth order of insects according to the Linnæan system, and so called on account of the nerves and veins disposed in their wings. The insects of this order have four wings: all of them membranaceous, reticulate; tail unarmed. There are seven genera, viz.

Ephemera	Panorpa
Hemerobius	Phryganea
Libellula	Raphidia
Myrmeleon	

which see.

NEUTRAL *salts*. See next article, also SALTS.

NEUTRALIZATION, in chemistry, may be thus explained. If we take a given quantity of sulphuric acid diluted with water, and add it slowly to the solution of soda by little at a time, and examine the mixture after every addition, we shall find that for a considerable time it will exhibit the properties of an acid, reddening vegetable blues, and having a taste perceptibly sour; but these acid properties gradually diminish after every addition of the alkaline solution, and at last disappear altogether. If we still add more of the soda, the mixture gradually acquires alkaline properties, converting vegetable blues to green, and manifesting an urinous taste. These properties become stronger and stronger the greater the quantity of the soda is which is added. Thus it appears that when sulphuric acid and soda are mixed together, the properties either of the one or the other preponderate according to the proportions of each; but that there are certain proportions, according to which, when they are combined, they mutually destroy or disguise the properties of each other, so that neither predominates, or rather so that both disappear. When substances thus mutually disguise each other's properties, they are said to neutralize one another. This property is common to a great number of bodies: but it manifests itself most strongly, and was first observed in the acids, alkalies, and earths. Hence the salts which are combinations of these different bodies received long ago the name of neutral salts.

NEWTON (SIR ISAAC), in biography, one of the greatest philosophers and mathematicians the world has produced, was born at Woolstrop, in Lincolnshire, on Christmas Day, 1642. He was descended from the eldest branch of the family of Sir John Newton, Bart. who were Lords of the manor of Woolstrop, and had been possessed of the estate for about two centuries before; to which they had removed from Westley, in the same county; but originally they came from the town of Newton, in Lancashire.

Other accounts say, probably with more truth, that he was the only child of Mr. John Newton, of Colesworth, near Grantham, in Lincolnshire, who had there an estate of about 120*l*. a year, which he kept in his own hands. His mother was of the ancient and opulent family of the Ayscoughs, or Ascews, of the same county. Our author losing his father while he was very young, the care of his education devolved on his mother, who, though she married again, did not neglect to improve by a liberal education the promising genius that was observed in her son. At twelve years of age, by the advice of his maternal uncle, he was sent to the grammar school at Grantham, where he made a good proficiency in the languages, and laid the foundation of his future studies. Even here was observed in him a strong inclination to figures and philosophical subjects. One trait of this early disposition is told of him: he had then a rude method of

measuring the force of the wind blowing against him, by observing how much farther he could leap in the direction of the wind, or blowing on his back, than he could leap the contrary way, or opposed to the wind; an early mark of his original infantine genius.

After a few years spent here, his mother took him home; intending, as she had no other child, to have the pleasure of his company; and that, after the manner of his father before him, he should occupy his own estate.

But instead of attending to the markets, or the business of the farm, he was always studying and poring over his books, even by stealth, from his mother's knowledge. On one of these occasions his uncle discovered him one day in a hay-loft at Grantham, whither he had been sent to the market, working a mathematical problem, and having otherwise observed the boy's mind to be uncommonly bent upon learning, he prevailed upon his sister to part with him; and he was accordingly sent, in 1660, to Trinity College, in Cambridge, where his uncle, having himself been a member of it, had still many friends. Isaac was soon taken notice of by Dr. Barrow, who was at this time appointed the first Lucasian professor of mathematics; and observing his bright genius, contracted a great friendship for him. At his commencement, Euclid was first put into his hands, as usual; but that author was soon dismissed, seeming to him too plain and easy, and unworthy of taking up his time. He understood him almost before he read him; and a cast of his eye upon the contents of his theorems, was sufficient to make him master of them: and as the analytical method of Des Cartes was then much in vogue, he particularly applied to it, and Kepler's optics, &c. making several improvements on them, which he entered upon the margins of the books as he went on, as his custom was in studying any author.

Thus he was employed till the year 1664, when he opened a way into his new method of Fluxions and Infinite Series; and the same year took the degree of Bachelor of Arts. In the mean time observing, that the mathematicians were much engaged in the business of improving telescopes, by grinding glasses into one of the figures made by the three sections of a cone, upon the principles then generally entertained, that light was homogeneous, he set himself to grinding of optic glasses, of other figures than spherical, having as yet no distrust of the homogenous nature of light; but not hitting presently upon any thing in this attempt to satisfy his mind, he procured a glass prism, that he might try the celebrated phenomena of colours, discovered by Grimaldi not long before. He was much pleased at first with the vivid brightness of the colours produced by this experiment; but after a while, considering them in a philosophical way, with that circumspection which was natural to him, he was surprised to see them in an oblong form, which, according to the received rule of refractions, ought to be circular. At first he thought the irregularity might possibly be no more than accidental; but this was what he could not leave without further enquiry: accordingly he soon invented an infallible method of deciding the question, and the result was his New Theory of Light and Colours.

However, the theory alone, unexpected and surprising as it was, did not satisfy him; he rather considered the proper use that might be made of it for improving telescopes, which was his first design. To this end, having now discovered that light was not homogeneous, but an heterogeneous mixture of differently refrangible rays, he computed the errors arising from this different refrangibility; and, finding them to exceed some hundreds of times those occasioned by the circular figure of the glasses, he threw aside his glass works, and began to consider the subject with precision. He was now sensible that optical instruments might be brought to any degree of perfection desired, in case there could be found a reflecting substance which could polish as finely as glass, and reflect as much light as glass transmits, and the art of giving it a parabolical figure he also attained; but these at first seemed to him very great difficulties; nay, he thought them almost insuperable, when he further considered, that every irregularity in a reflecting superficies makes the rays stray five or six times more from their due course, than the like irregularities in a refracting one.

Amidst these speculations, he was forced from Cambridge, in 1665, by the plague; and it was more than two years before he made any further progress in the subject. However, he was far from passing his time idly in the country; on the contrary, it was here, at this time, that he first started the hint that gave rise to the system of the world, which is the main subject of the Principia. In his retirement he was sitting alone in a garden, when some apples falling

from a tree, led his thoughts upon the subject of gravity; and, reflecting on the power of that principle, he began to consider, that, as this power is not found to be sensibly diminished at the remotest distance from the centre of the earth, to which we can rise, neither at the tops of the loftiest buildings, nor on the summits of the highest mountains, it appeared to him reasonable to conclude, that this power must extend much further, than is usually thought.—"Why not as high as the moon?" said he to himself; "and if so, her motion must be influenced by it; perhaps she is retained in her orbit by it; however, though the power of gravity is not sensibly weakened in the little change of distance at which we can place ourselves from the centre of the earth, yet it is very possible that, at the height of the moon, this power may differ in strength much from what it is here." To make an estimate of what might be the degree of this diminution, he considered with himself, that if the moon be retained in her orbit by the force of gravity, no doubt the primary planets are carried about the sun by the like power; and by comparing the periods of the several planets with their distances from the sun, he found, that if any power like gravity held them in their courses, its strength must decrease in the duplicate proportion of the increase of distance. This he concluded, by supposing them to move in perfect circles, concentric to the sun, from which the orbits of the greatest part of them do not much differ. Supposing, therefore, the force of gravity, when extended to the moon, to decrease in the same manner, he computed whether that force would be sufficient to keep the moon in her orbit.

In this computation being absent from books, he took the common estimate in use among the geographers and our seamen, before Norwood had measured the earth, namely, that sixty miles make one degree of latitude; but as that is a very erroneous supposition, each degree containing about sixty-nine and one-third of our English miles, his computation upon it did not make the power of gravity, decreasing in a duplicate proportion to the distance, answerable to the power which retained the moon in her orbit. whence he concluded, that some other cause must at least join with the action of the power of gravity on the moon. For this reason he laid aside at that time any farther thoughts upon the matter. Mr. Whiston (in his Memoirs, p. 35) says he told him that he thought Des Cartes's vortices might concur with the action of gravity.

Nor did he resume this enquiry on his return to Cambridge, which was shortly after. The truth is, his thoughts were now engaged upon his newly projected reflecting telescope, of which he made a small specimen with a metallic reflector spherically concave. It was but a rude essay, chiefly defective by the want of a good polish for the metal. This instrument is now in the possession of the Royal Society. In 1667, he was chosen fellow of his college, and took the degree of master of arts. And in 1669, Dr. Barrow resigned to him the mathematical chair at Cambridge, the business of which appointment interrupted, for a while, his attention to the telescope; however, as his thoughts had been for some time chiefly employed upon optics, he made his discoveries in that science the subject of his lectures for the first three years after he was appointed mathematical professor: and having now brought his theory of light and colours, to a considerable degree of perfection, and having been elected a Fellow of the Royal Society, in January 1672, he communicated it to that body, to have their judgment upon it; and it was afterwards published in their Transactions, viz. of February 19, 1672. This publication occasioned a dispute upon the truth of it, which gave him so much uneasiness, that he resolved not to publish any thing further for a while upon the subject; and in that resolution he laid by his optical lectures, although he had prepared them for the press. And the analysis by infinite series, which he had intended to subjoin to them, unhappily for the world, underwent the same fate, and for the same reason.

In this temper he resumed his telescope, and observing that there was no absolute necessity for the parabolic figure of the glasses, since, if metals could be ground truly spherical, they would be able to bear as great apertures as men could give a polish to, he completed another instrument of the same kind. This answering the purpose so well, as, though only half a foot in length, to show the planet Jupiter distinctly round, with his four satellites, and also Venus horned, he sent it to the Royal Society, at their request, together with a description of it, with farther particulars, which were published in the Philosophical Transactions for March, 1672. Several attempts were also made by that society to bring it to per-

fection; but for want of a proper composition of metal, and a good polish, nothing succeeded, and the invention lay dormant till Hadley made his Newtonian telescope in 1723. At the request of Leibnitz, in 1676, he explained his invention of Infinite Series, and took notice how far he had improved it by his method of Fluxions, which however he still concealed, and particularly on this occasion, by a transposition of the letters that make up the two fundamental propositions of it, into an alphabetical order; the letters concerning which are inserted in Collins's "Commercium Epistolicum," printed 1712. In the winter, between the years 1676, and 1677, he found out the grand proposition, that, by a centripetal force acting reciprocally as the square of the distance, a planet must revolve in an ellipsis, about the centre of force placed in its lower focus, and, by a radius drawn to that centre, describe areas proportional to the times. In 1680 he made several astronomical observations upon the comet that then appeared; which, for some considerable time, he took not to be one and the same, but two different comets; and upon this occasion several letters passed between him and Mr. Flamsteed.

He was still under this mistake, when he received a letter from Dr. Hook, explaining the nature of the line described by a falling body, supposed to be moved circularly by the diurnal motion of the earth, and perpendicularly by the power of gravity. This letter put him upon enquiring anew what was the real figure in which such a body moved; and that enquiry convincing him of another mistake which he had before fallen into concerning that figure, put him upon resuming his former thoughts with regard to the moon; and Picart having not long before, *viz.* in 1679, measured a degree of the earth with sufficient accuracy, by using his measures, that planet appeared to be retained in her orbit by the sole power of gravity; and, consequently, that this power decreases in the duplicate ratio of the distance; as he had formerly conjectured. Upon this principle he found the line described by a falling body to be an ellipsis, having one focus in the centre of the earth. And finding by this means, that the primary planets really moved in such orbits as Kepler had supposed, he had the satisfaction to see that this enquiry, which he had undertaken at first out of mere curiosity, could be applied to the greatest purposes. Hereupon he drew up about a dozen propositions, relating to the motion of the primary planets, round the sun, which were communicated to the Royal Society in the latter end of 1683. This coming to be known to Dr. Halley, that gentleman, who had attempted the demonstration in vain, applied, in August, 1684, to Newton, who assured him that he had absolutely completed the proof. This was also registered in the books of the Royal Society; at whose earnest solicitation Newton finished the work, which was printed under the care of Dr. Halley, and came out about Midsummer, 1687, under the title of "Philosophiæ Naturalis Principia Mathematica," containing, in the third book, the cometic astronomy, which had been lately discovered by him, and now made its first appearance in the world: a work which may be looked upon as the production of a celestial intelligence rather than of a man.

This work, however, in which the great author has built a new system of natural philosophy, upon the most sublime geometry, did not meet at first with all the applause it deserved, and was one day to receive. Two reasons concurred in producing this effect: Des Cartes had then got full possession of the world. His philosophy was indeed the creature of a fine imagination, gaily dressed out: he had given her likewise some of nature's fine features, and painted the rest to a seeming likeness of her. On the other hand, Newton had, with an unparalleled penetration and force of genius, pursued nature up to her most secret abode, and was intent to demonstrate her residence to others, rather than anxious to describe particularly the way by which he arrived at it himself: he finished that piece in that elegant conciseness, which had justly gained the ancients a universal esteem. In fact, the consequences flow with such rapidity from the principles, that the reader is often left to supply a long chain of reasoning to connect them, so that it required some time before the world could understand it. The best mathematicians were obliged to study it with care, before they could make themselves masters of it; and those of a lower rank durst not venture upon it, till encouraged by the testimonies of the more learned. But at last, when its value came to be sufficiently known, the approbation which had been so slowly gained, became universal, and nothing was to be heard from all quarters, but one general burst of admiration. "Does Mr. Newton eat, drink, or sleep, like other

men?" says the Marquis De l'Hospital, one of the greatest mathematicians of the age, to the English who visited him. "I represent him to myself as a celestial genius entirely disengaged from matter."

In the midst of these profound mathematical researches, just before his Principia went to the press in 1686, the privileges of the University being attacked by James the Second, Newton appeared among its most strenuous defenders, and was on that occasion appointed one of their delegates to the High-commission Court; and they made such a defence, that James thought proper to drop the affair. Our author was also chosen one of their members for the Convention Parliament, in 1688, in which he sat till it was dissolved.

Newton's merit was well known to Mr. Montague, then Chanceller of the Exchequer, and afterwards Earl of Halifax, who had been bred at the same college with him; and when he undertook the great work of recoining the money, he fixed his eye upon Newton, for an assistant in it; and accordingly, in 1696, he was appointed Warden of the Mint, in which employment he rendered very signal service to the nation. And three years after he was promoted to be Master of the Mint, a place worth 12 or 1500*l.* per annum, which he held till his death. Upon this promotion he appointed Mr. Whiston his deputy in the mathematical professorship at Cambridge, giving him the full profits of the place, which appointment itself he also procured for him in 1703. The same year our author was chosen President of the Royal Society, in which chair he sat for 25 years, namely, till the time of his death; and he had been chosen a member of the Royal Academy of Sciences at Paris, in 1699, as soon as the new regulation was made for admitting foreigners into that society.

Ever since the first discovery of the heterogeneous mixture of light, and the production of colours thence arising, he had employed a good part of his time in bringing the experiment upon which the theory is founded, to a degree of exactness that might satisfy himself. The truth is, this seems to have been his favourite invention; thirty years he had spent in this arduous task, before he published it in 1704. In infinite series and fluxions, and in the power and rule of gravity, in preserving the solar system, there had been some, though distant hints, given by others before him; whereas in dissecting a ray of light into its primary constituent particles, which then admitted of no further separation, in the discovery of the different refrangibilities of these particles thus separated; and that these constituent rays had each its own peculiar colour inherent in it; that rays falling in the same angle of incidence have alternate fits of reflection and refraction; that bodies are rendered transparent by the minuteness of their pores, and become opaque by having them large; and that the most transparent body, by having a great thinness, will become less pervious to the light; in all these, which make up his new theory of light and colours, he was absolutely and entirely the first starter; and as the subject is of the most subtile and delicate nature, he though it necessary to be himself the last finisher of it.

In fact, the affair that chiefly employed his researches for so many years was far from being confined to the subject of light alone. On the contrary, all that we know of natural bodies seemed to be comprehended in it; he had found out that there was a natural action, at a distance, between light and other bodies, by which both the reflections and refractions, as well as inflections, of the former, were constantly produced. To ascertain the force and extent of this principle of action was what had all along engaged his thoughts, and what, after all, by its extreme subtlety, escaped his most penetrating spirit. However, though he has not made so full a discovery of this principle, which directs the course of light, as he has in regard to the power by which the planets are kept in their courses; yet he gave the best directions possible for such as should be disposed to carry on the work, and furnished matter abundantly sufficient to animate them to the pursuit. He has, indeed, hereby opened a way of passing from optics to an entire system of physics; and, if we look upon his queries as containing the history of a great man's first thoughts, even in that view they must be always at least entertaining and curious.

This same year, and in the same book with his Optics, he published, for the first time, his Method of Fluxions. It has been already observed, that these two inventions were intended for the public so long before as 1672; but were laid by then, in order to prevent his being engaged on that account in a dispute about them. And it is not a little remarkable that, even now, this last piece proved the occasion of another dispute, which continued for many years.

Ever since 1684, Leibnitz had been artfully working the world into an opinion, that he first invented this method. Newton saw his design from the beginning, and had sufficiently obviated it in the first edition of the "Principia," in 1687, (viz. in the Scholium to the 2nd lemma of the 2nd book): and with the same view, when he now published that method, he took occasion to acquaint the world that he invented it in the years 1665 and 1666. In the "Acta Eruditorum" of Leipsic, where an account is given of this book, the author of that account ascribed the invention to Leibnitz, intimating that Newton borrowed it from him. Dr. Keill, astronomical professor at Oxford, undertook Newton's defence; and after several answers on both sides, Leibnitz complaining to the Royal Society, this body appointed a committee of their members to examine the merits of the case. These, after considering all the papers and letters relating to the point in controversy, decided in favour of Newton and Keill; as is related at large in the life of the last-mentioned gentleman; and these papers themselves were published in 1712, under the title of "Commercium Epistolicum Johannis Collins," 8vo.

In 1705, the honour of knighthood was conferred upon our author by Queen Anne, in consideration of his great merit. And in 1714, he was applied to by the House of Commons, for his opinion upon a new method of discovering the longitude at sea by signals, which had been laid before them by Ditton and Whiston, in order to procure their encouragement; but the petition was thrown aside upon reading Newton's paper delivered to the committee.

The following year, 1715, Leibnitz, with the view of bringing the world more easily into the belief that Newton had taken the Method of Fluxions from his Differential Method, attempted to foil his mathematical skill by the famous problem of the trajectories, which he, therefore, proposed to the English by way of challenge: but the solution of this, though the most difficult proposition he was able to devise, and what might pass for an arduous affair to any other, yet was hardly any more than an amusement to Newton's penetrating genius: he received the problem at 4 o'clock in the afternoon, as he was returning from the Mint; and, though extremely fatigued with business, yet he finished the solution before he went to bed.

As Leibnitz was Privy-Counceller of Justice to the Elector of Hanover, so when that prince was raised to the British throne, Newton came more under the notice of the court; and it was for the immediate satisfaction of George the First, that he was prevailed on to put the last hand to the dispute about the invention of fluxions. In this court, Caroline, Princess of Wales, afterwards Queen consort to George the Second, happened to have a curiosity for philosophical inquiries; no sooner, therefore, was she informed of our author's attachment to the House of Hanover, than she engaged his conversation, which soon endeared him to her. Here she found, in every difficulty, that full satisfaction which she had in vain sought for elsewhere; and she was often heard to declare, publicly, that she thought herself happy in coming into the world at a juncture of time which put it in her power to converse with him. It was at this Princess's solicitations that he drew up an abstract of his Chronology, a copy of which was at her request communicated about 1718, to Signior Conti, a Venetian nobleman, then in England, upon a promise to keep it secret. But, notwithstanding this promise, the abbé, who while here had also affected to shew a particular friendship for Newton, though privately betraying him, as much as lay in his power, to Leibnitz, was no sooner got across the water, into France, than he dispersed copies of it, and procured an antiquary to translate it into French, as well as to write a confutation of it. This, being printed at Paris, in 1725, was delivered as a present, from the bookseller that printed it, to our author, that he might obtain, as was said, his consent to the publication; but though he expressly refused such consent, yet the whole was published the same year. Hereupon Newton found it necessary to publish a defence of himself, which was inserted in the Philos. Trans. Thus, he who had so much all his life long been studious to avoid disputes, was unavoidably all his lifetime, in a manner, involved in them; nor did this last dispute even finish at his death, which happened the year following. Newton's paper was republished in 1726, at Paris, in French, with a letter of the Abbé Conti, in answer to it; and the same year some dissertations were printed there by Father Souciet, against Newton's Chronological Index; an answer to which was inserted, by Halley, in the Philos. Trans. No. 397.

Some time before this business, in his 80th year, our author was seized with an

incontinence of urine, thought to proceed from the stone in the bladder, and deemed to be incurable. However, by the help of a strict regimen and other precautions, which till then he never had occasion for, he procured considerable intervals of ease during the five remaining years of his life. Yet he was not free from some severe paroxysms, which even forced out large drops of sweat that ran down his face. In these circumstances he was never observed to utter the least complaint, nor express the smallest impatience; and as soon as he had a moment's ease he would smile and talk with his usual cheerfulness. He was now obliged to rely upon Mr. Conduit, who had married his niece, for the discharge of his office in the Mint. Saturday morning, March 18, 1727, he read the newspapers, and discoursed a long time with Dr. Mead, his physician, having then the perfect use of all his senses and his understanding; but that night he entirely lost them all, and not recovering them afterwards, died the Monday following, March 20, in the 85th year of his age. His corpse lay in state in the Jerusalem Chamber, and on the 28th was conveyed into Westminster-Abbey, the pall being supported by the Lord Chancellor, the Dukes of Montrose and Roxburgh, and the Earls of Pembroke, Sussex, and Macclesfield. He was interred near the entrance into the choir, on the left hand, where a stately monument is erected to his memory, with a most elegant inscription upon it.

Newton's character has been attempted by Mr. Fontenelle and Dr. Pemberton, the substance of which is as follows. He was of a middle stature, and somewhat inclined to be fat in the latter part of his life. His countenance was pleasing and venerable at the same time, especially when he took off his peruke, and shewed his white hair, which was pretty thick. He never made use of spectacles, and lost but one tooth during his whole life. Bishop Atterbury says, that in the whole air of Sir Isaac's face and make, there was nothing of that penetrating sagacity which appears in his compositions, that he had something rather languid in his look and manner, which did not raise any great expectation in those who did not know him.

His temper, it is said, was so equal and mild, that no accident could disturb it. A remarkable instance of which is related as follows. Sir Isaac had a favourite little dog, which he called Diamond. Being one day called out of his study into the next room, Diamond was left behind. When Sir Isaac returned, having been absent but a few minutes, he had the mortification to find that Diamond having overset a lighted candle among some papers, the nearly finished labour of many years was in flames, and almost consumed to ashes. This loss, as Sir Isaac was then very far advanced in years, was irretrievable; yet without once striking the dog, he only rebuked him with this exclamation: "Oh! Diamond! Diamond! thou little knowest the mischief thou hast done!"

He was indeed of so meek and gentle a disposition, and so great a lover of peace, that he would rather have chosen to remain in obscurity, than to have the calm of life ruffled by those storms and disputes, which genius and learning always draw upon those that are most eminent for them.

From his love of peace, no doubt, arose that unusual kind of horror which he felt for all disputes: a steady unbroken attention, free from those frequent recoilings inseparably incident to others, was his peculiar felicity; he knew it, and he knew the value of it. No wonder then that controversy was looked on as his bane. When some objections, hastily made to his discoveries concerning light and colours, induced him to lay aside the design he had taken of publishing his optical lectures, we find him reflecting on that dispute, into which he had been unavoidably drawn, in these terms: "I blamed my own imprudence for parting with so real a blessing as my quiet, to run after a shadow." It is true this shadow, as Fontenelle observes, did not escape him afterwards, nor did it cost him that quiet which he so much valued, but proved as much a real happiness to him as his quiet itself; yet this was a happiness of his own making; he took a resolution from these disputes, not to publish any more concerning that theory, till he had put it above the reach of controversy, by the exactest experiments, and the strictest demonstrations; and accordingly it has never been called in question since. In the same temper, after he had sent the manuscript to the Royal Society, with his consent to the printing of it by them; yet upon Hook's injuriously insisting that he himself had demonstrated Kepler's problem before our author, he determined rather than be again involved in a controversy to suppress the third book, and he was very hardly prevailed upon to alter

that resolution. It is true, the public was thereby a gainer; that book, which is indeed no more than a corollary of some propositions in the first, being originally drawn up in the popular way, with a design to publish it in that form; whereas he was now convinced that it would be best, not to let it go abroad without a strict demonstration.

In contemplating his genius, it presently becomes a doubt which of these endowments had the greatest share, sagacity, penetration, strength, or diligence: and after all, the mark that seems most to distinguish it is, that he himself made the justest estimation of it, declaring, that if he had done the world any service, it was due to nothing but industry and patient thought; that he kept the subject of consideration constantly before him, and waited till the first dawning opened gradually, by little and little, into a full and clear light. It is said, that when he had any mathematical problems or solutions in his mind, he would never quit the subject on any account. And his servant has said, when he has been getting up in a morning he has sometimes begun to dress, and with one leg in his breeches sat down again on the bed, where he has remained for hours before he has got his clothes on: and that dinner has been often three hours ready for him before he could be brought to table. Upon this head several little anecdotes are related; among which is the following. Dr. Stukely coming in accidentally one day, when Newton's dinner was left for him upon the table, covered up, as usual, to keep it warm till he could find it convenient to come to table; the doctor, lifting the cover found under it a chicken, which he presently ate, putting the bones in the dish, and replacing the cover. Some time after Newton came into the room, and after the usual compliments sat down to his dinner; but on taking up the cover and seeing only the bones of the fowl left, he observed with some little surprise, "I thought I had not dined, but I now find that I have."

After all, notwithstanding his anxious care to avoid every occasion of breaking his intense application to study, he was at a great distance from being steeped in philosophy. On the contrary, he could lay aside his thoughts, though engaged in the most intricate researches, when his other affairs required his attention: and, as soon as he had leisure, resume the subject at the point where he had left off. This he seems to have done not so much by any extraordinary strength of memory, as by the force of his inventive faculty, to which every thing opened itself again with ease, if nothing intervened to ruffle him. The readiness of his invention made him not think of putting his memory much to the trial; but this was the offspring of a vigorous intenseness of thought, out of which he was but a common man. He spent therefore the prime of his age in those abstruse researches, when his situation in a college gave him leisure, and while study was his proper business. But as soon as he was removed to the Mint, he applied himself chiefly to the duties of that office; and so far quitted mathematics and philosophy, as not to engage in any pursuits of either kind afterwards.

Dr. Pemberton observes, that though his memory was much decayed, in the last years of his life, yet he perfectly understood his own writings, contrary to what I had formerly heard, says the Doctor, in discourse from many persons. This opinion of theirs might arise perhaps from his not being always ready at speaking on these subjects, when it might be expected he should. But on this head it may be observed, that great geniuses are often liable to be absent, not only in relation to common life, but with regard to some of the parts of science that they are best informed of; inventors seem to treasure up in their minds what they have found out, after another manner than those do the same things who have not this inventive faculty. The former, when they have occasion to produce their knowledge, are in some measure obliged immediately to investigate part of what they want; and for this they are not equally fit at all times; from whence it has often happened, that such as retain things chiefly by means of a very strong memory, have appeared off-hand more expert than the discoverers themselves.

It was evidently owing to the same inventive faculty that Newton, as this writer found, had read fewer of the modern mathematicians than one could have expected; his own prodigious invention readily supplying him with what he might have occasion for in the pursuit of any subject he undertook. However he often censured the handling of geometrical subjects of algebraic calculations; and his book of Algebra, he called by the name of Universal Arithmetic, in opposition to the injudicious

persecution of the nonconformists. He judged of men by their manners, and the true schismatics, in his opinion, were the vicious and the wicked. Not that he confined his principles to natural religion, for it is said he was thoroughly persuaded of the truth of revelation; and amidst the great variety of books which he had constantly before him, that which he studied with the greatest application was the Bible, at least in the latter years of his life; and he understood the nature and force of moral certainty, as well as he did that of a strict demonstration.

Sir Isaac did not neglect the opportunities of doing good, when the revenues of his patrimony and a profitable employment, improved by a prudent economy, put it in his power. We have two remarkable instances of his bounty and generosity; one to Mr. Maclaurin, extra professor of mathematics at Edinburgh, to encourage whose appointment he offered 20*l.* a year, to that office; and the other to his niece Barton, upon whom he settled an annuity of 100*l.* per annum. When decency upon any occasion required expense and shew, he was magnificent without grudging it, and with a very good grace; at all other times, that pomp which seems great to low minds only, was utterly retrenched, and the expense reserved for better uses.

Newton never married; and it has been said, that "perhaps he never had leisure to think of it; that, being immersed in profound studies during the prime of his age, and afterwards engaged in an employment of great importance, and even quite taken up with the company which his merit drew to him, he was not sensible of any vacancy in life, nor the want of a companion at home." These however do not appear to be any sufficient reasons for his never marrying, if he had had an inclination so to do. It is much more likely that he had a constitutional indifference to the state, and even to the sex in general.

He left at his death, it seems, 32,000*l.*, but he made no will; which, Fontenelle tells us, was because he thought a legacy was no gift. As to his works, besides what were published in his lifetime, there were found after his death, among his papers, several discourses upon the subjects of antiquity, history, divinity, chemistry, and mathematics; several of which were published at different times, as appears from the following catalogue of all his works; where they are ranked in the order of time in which those upon the same subject were published.

1. Several Papers relating to his Telescope, and his Theory of Light and Colours, printed in the Philosophical Transactions, Numbers 80, 81, 82, 83, 84, 85, 88, 96, 97, 110, 121, 123, 128; or Vols. 6, 7, 8, 9, 10, 11.

2. Optics, or a Treatise of the Reflections, Refractions, and Inflections, and the Colours of Light, 1704, 4to. A Latin Translation, by Dr. Clarke, 1706, 4to.; and a French Translation, by P. Caste, Amst. 1729, 2 vols. 12mo. Besides several English editions in 8vo.

3. Optical Lectures, 1728, 8vo.; also in several Letters to Mr. Oldenburg, Secretary to the Royal Society, inserted in the General Dictionary, under our author's article.

4. Lectiones Opticæ, 1729, 4to.

5. Naturalis Philosophiæ Principia Mathematica, 1687, 4to. A second edition in 1713, with a Preface by Roger Cotes. The third edition in 1726, under the direction of Dr. Pemberton. An English Translation by Motte, 1729, 2 vols. 8vo. printed in several editions of his works, in different nations, particularly an edition, with a large Commentary by the two learned Jesuits, Le Seur and Jacquier, in 4 vols. 4to. in 1739, 1740, and 1742.

6. A System of the World, translated from the Latin original, 1727, 8vo. This, as has been already observed, was at first intended to make the third book of his Principia. An English Translation, by Motte, 1729, 8vo.

7. Several Letters to Mr. Flamsteed, Dr. Halley, and Mr. Oldenburg.

8. A Paper concerning the Longitude, drawn up by order of the House of Commons.

9. Abregé de Chronologie, &c. 1726, under the direction of the Abbé Conti, together with some Observations upon it.

10. Remarks upon the Observations made upon a Chronological Index of Sir I. Newton, &c. Philosophical Transactions, vol. 33. See also the same, vols. 34 and 35, by Dr. Halley.

11. The Chronology of Ancient Kingdoms amended, &c. 1728, 4to.

12. Arithmetica Universalis, &c. under the inspection of Mr. Whiston, Cantab. 1707, 8vo. Printed without the author's consent, and even against his will, an offence which, it seems, was never forgiven.

There are also English editions of the same, particularly one by Wilder, with a Commentary, in 1769, 2 vols. 8vo.; and a Latin edition, with a Commentary, by Castilion, 2 vols. 4to. Amst. &c.

13. Analysis per Quantitatum Seriæs, Fluxiones, et Differentias, cum Enumeratione Linearum Tertii Ordinis, 1711, 4to. under the inspection of W. Jones, Esq. F. R. S. The last tract had been published before, together with another on the Quadrature of Curves, by the method of Fluxions, under the title of Tractatus duo de Speciebus et Magnitudine Figurarum Curvilinearum, subjoined to the first edition of his Optics, in 1704, and other Letters in the Appendix to Dr. Gregory's Catoptrics, &c. 1735, 8vo. Under this head may be ranked Newtoni Genesis Curvarum per Umbras, Leyden, 1740.

14. Several Letters relating to his dispute with Leibnitz, upon his right to the Invention of Fluxions; printed in the Commercium Epistolicum D. Johannis Collins et Aliorum, de Analysi Promota, jussu Societatis Regiæ editum, 1712, 8vo.

15. Postscript and Letter of M. Leibnitz to the Abbé Conti, with remarks, and a Letter of his own to that Abbé, 1717, 8vo. To which was added Raphson's History of Fluxions, as a Supplement.

16. The Method of Fluxions and Analysis, by Infinite Series, translated into English from the original Latin; to which is added, a Perpetual Commentary by the Translator, Mr. John Colson, 1736, 4to.

17. Several Miscellaneous Pieces and Letters, as follows: 1. A Letter to Mr. Boyle upon the Subject of the Philosopher's Stone; inserted in the General Dictionary under the article Boyle. 2. A Letter to Mr. Aston, containing Directions for his Travels; ibid. under our Author's article. 3. An English Translation of a Latin Dissertation upon the Sacred Cubit of the Jews; inserted among the Miscellaneous Works of Mr. John Greaves, vol. 2, published by Dr. Thomas Birch, in 1737, 2 vols. 8vo. This Dissertation was found subjoined to a work of Sir Isaac's, not finished, intitled Lexicon Propheticum. 4. Four Letters from Sir Isaac Newton to Dr. Bentley, containing some Arguments in Proof of a Deity, 1756, 8vo. 5. Two Letters to Mr. Clarke, &c.

18. Observations on the Prophecies of Daniel, and the Apocalypse of St. John, 1733, 4to.

19. Is. Newtoni Elementa Perspectivæ Universalis, 1746, 8vo.

20. Tables for Purchasing College Leases, 1742, 12mo.

21. Corollaries, by Whiston.

22. A Collection of several Pieces of our Author's, under the following title: Newtoni Is. Opuscula Mathematica Philos. et Philol. Collegit I. Castilioneus, Laus. 1744, 4to. 8 tomes.

23. Two Treatises of the Quadrature of Curves, and Analysis by Equations of an Infinite Number of Terms explained, translated by John Stewart, with a large Commentary, 1745, 4to.

24. Description of an Instrument for Observing the Moon's Distance from the Fixed Stars at Sea. Philosophical Transactions, vol. 42.

25. Newton also published Barrow's Optical Lectures, in 1699, 4to.; and Bern. Varenii Geographia, &c. 1681, 8vo.

26. The Whole Works of Newton, published by Dr. Horsley, 1779, 4to. in five volumes.

NEWTONIAN *philosophy*, the doctrine of the Universe, and particularly of the Heavenly bodies; their laws, affections, &c. as delivered by Sir Isaac Newton. The term Newtonian philosophy is applied very differently by different authors. Some under this philosophy include all the Corpuscular philosophy, considered as it now stands corrected and reformed by the discoveries and improvements made in the several parts thereof by Sir Isaac Newton. In this sense it is that 's Gravesande calls his Elements of Physics, an Introduction to the Newtonian philosophy; and in this sense, the Newtonian is the same with the new philosophy, in opposition to the Cartesian, the Peripatetic, and the ancient Corpuscular philosophy. Others, by Newtonian philosophy, mean the method or order which Sir Isaac observes in philosophizing, *viz.* the reasoning and drawing of conclusions directly from phenomena, exclusive of all previous hypotheses; the beginning from simple principles, deducing the first powers and laws of nature from a few select phenomena, and then applying those laws, &c. to account for other things; and in this sense the Newtonian is the same with Experimental philosophy. Others again, by Newtonian philosophy, mean that wherein physical bodies are considered mathematically, and where geometry and mechanics are applied to the solution of phenomena; in which sense the Newtonian is the same

with the mechanical and mathematical philosophy. Others again, by Newtonian philosophy, understand that part of physical knowledge which Sir Isaac Newton has handled, improved, and demonstrated in his Principia. And, lastly, some by Newtonian philosophy, mean the new principles which Sir Isaac has brought into philosophy, the new system founded thereon, and the new solutions of phenomena thence deduced; or that which characterizes and distinguishes his philosophy from all others: and this is the sense, in which we shall chiefly consider it.

As to the history of this philosophy, we have but little to say: it was first made public in 1686, by the author, then a fellow of Trinity College, Cambridge; and in the year 1713, republished with considerable improvements. Several other authors have since attempted to make it plainer, by setting aside many of the more sublime mathematical researches, and substituting either more obvious reasonings or experiments in lieu thereof; particularly Mr. Whiston, in his Prelect. Phys. Mathem. 's Gravesande, in his Elem. and Inst. and the learned Comment of Le Seur and Jacquier upon Sir Isaac's Principia.

The philosophy itself is laid down chiefly in the third book of the Principia; the two preceding books being taken up in preparing the way, and demonstrating such principles of mathematics as have the most relation to philosophy: such are the laws and conditions of powers; and these, to render them less dry and geometrical, the author illustrates by scholia in philosophy, relating chiefly to the density and resistance of bodies, the motion of light and sounds, a vacuum, &c. In the third book he proceeds to the philosophy itself; and from the same principles deduces the structure of the universe, and the powers of gravity, whereby bodies tend towards the Sun and planets; and, from these powers, the motions of the planets and comets, the theory of the Moon and the tides. This book, which he calls De Mundi Systemate, he tells us, was first written in the popular way; but considering, that such as are unacquainted with the said principles, would not conceive the force of the consequences, nor be induced to lay aside their ancient prejudices; for this reason, and to prevent the thing from being in continual dispute, he digested the sum of that book into propositions, in the mathematical manner, so as it might only come to be read by such as had first considered the principles; not that it is necessary a man should master them all, many of them, even the first rate mathematicians, would find a difficulty in getting over. It is enough to have read the definitions, laws of motion, and the three first sections of the first book; after which, the author himself directs us to pass on to the book De Systemate Mundi.

The great principle on which the whole philosophy is founded, is the power of gravity: this principle is not new; Kepler, long ago, hinted at it in his Introduct. ad Mot. Martis. He even discovered some of the properties thereof, and their effects in the motions of the primary planets; but the glory of bringing it to a physical demonstration, was reserved to the English philosopher. See GRAVITATION. His proof of this principle from phenomena, together with the application of the same principle to the various other appearances of nature, or the deducing those appearances from that principle, constitute the Newtonian system; which, drawn in miniature, will stand thus:

I. The phenomena are, 1. That the satellites of Jupiter do, by radii drawn to the centre of the planet, describe areas proportional to the times; and that their periodical times are in a sesquiplicate ratio of their distances from its centre; in which the observations of all astronomers agree. 2. The same phenomenon holds of the satellites of Saturn, with regard to Saturn; and of the Moon, with regard to the Earth. 3. The periodical times of the primary planets about the Sun, are in a sesquiplicate ratio of their mean distances from the Sun. But, 4. The primary planets do not describe areas any way proportional to their periodical times about the Earth; as being sometimes seen stationary, and sometimes retrograde, with regard thereto.

II. The powers whereby the satellites of Jupiter are constantly drawn out of their rectilinear course, and retained in their orbits, respect the centre of Jupiter, and are reciprocally as the squares of their distances from the same centre. The same holds of the satellites of Saturn, with regard to Saturn; of the Moon, with regard to the Earth; and of the primary planets, with regard to the Sun. See CENTRAL FORCES.

III. The Moon gravitates towards the Earth, and by the power of that gravity is retained in her orbit: and the same holds of the other satellites with respect to their

diameter of their orbits directly, and as the squares of the periodical times inversely; and the weights at any distance from the centre of the planet are greater or less in a duplicate ratio of their distances inversely. And since the quantities of matter in the planets are as their powers at equal distances from their centres: and, lastly, since the weights of equal and homogeneous bodies towards homogeneous spheres are, at the surfaces of the spheres, as the diameters of those spheres; and consequently, the densities of heterogeneous bodies are as the weights at the diameters of the spheres.

VI. The common centre of gravity of the Sun, and all the planets is at rest; and the Sun, though always in motion, yet never recedes far from the common centre of all the planets.

For the matter in the Sun being to that in Jupiter as 1033 to 1; and Jupiter's distance from the Sun to the semi-diameter of the Sun in a ratio somewhat bigger; the common centre of gravity of Jupiter and the Sun will be a point a little without the Sun's surface; and by the same means, the common centre of Saturn and the Sun will be a point a little within the Sun's surface; and the common centre of the Earth, and all the planets, will be scarce one diameter of the Sun distant from the centre thereof; but the centre is always at rest; therefore, though the Sun will have a motion this and that way, according to the various situations of the planets, yet it can never recede far from the centre; so that the common centre of gravity of the Earth, Sun, and Planets, may be esteemed the centre of the whole world. See PLANET.

VII. The planets move in ellipses that have their foci in the centre of the Sun; and describe areas proportionable to their times. This we have already laid down *à posteriori* as a phenomenon; and now that the principle of the heavenly motions is shewn, we deduce it therefrom *à priori*. Thus, since the weights of the planets towards the Sun are reciprocally as the squares of their distances from the centre of the Sun; if the Sun were at rest, and the other planets did not act on each other, their orbits would be elliptical, having the Sun in the common umbilicus, and would describe areas proportionable to the times; but the mutual actions of the planets are very small, and may be well thrown aside.

Indeed, the action of Jupiter on Saturn is of some consequence; and hence, according to the different situation and distances of those two planets, their orbits will be a little disturbed. The Earth's orbit too is sensibly disturbed by the action of the Moon; and the common centre of the two describes an ellipsis round the Sun placed in the umbilicus; and, with a radius drawn to the centre of the Sun, describes areas proportionable to the times. See EARTH, &c.

VIII. The aphelia and nodes of the planets are at rest, excepting for some inconsiderable irregularities arising from the action of the revolving planets and comets. Consequently, as the fixed stars retain their position to the aphelia and nodes, they too are at rest.

IX. The axis, or polar diameter, of the planets is less than the equatorial diameter. The planets, had they no diurnal rotation, would be spheres, as having an equal gravity on every side: but by this rotation the parts receding from the axis endeavour to rise towards the equator, which, if the matter they consist of be fluid, will be affected very sensibly. Accordingly, Jupiter, whose density is found not much to exceed that of water on our globe, is observed by astronomers to be considerably less between the two poles than from east to west. And, on the same principle, unless our Earth were higher at the equator than towards the poles, the sea would rise under the equator, and overflow all near it. But this figure of the Earth Sir Isaac Newton proves likewise *à posteriori*, from the oscillations of pendulums being slower and smaller in the equinoctial, than in the polar parts of the globe. See EARTH.

X. All the Moon's motions, and all the inequalities of these motions, follow from these principles, *e. gr.* her unequal velocity, and that of her nodes and apogee in the syzygies and quadratures; the differences in her excentricity and her variation. See MOON.

XI. From the inequalities of the lunar motions, we can deduce the several inequalities in the motions of the satellites.

XII. From these principles, particularly the action of the Sun and Moon upon the Earth, it follows, that we must have tides, or that the sea must swell and subside twice every day. See TIDES.

XIII. Hence, likewise, follows the whole theory of comets, as that they are above the region of the Moon, and in the planetary spaces; that they shine by the Sun's light, reflected from them; that they move in conic sections, whose umbilici are in the centre of the Sun; and, by radii drawn to

the Sun, describe areas proportional to the times; that the orbits, or trajectories, are very nearly parabola's; that their bodies are solid, compact, &c. like those of the planets, and must therefore acquire an immense heat in their perihelia; that their tails are exhalations arising from and encompassing them like atmospheres. See ASTRONOMY.

NEW *trial*, in law. Formerly the only remedy for a reversal of a verdict unduly given, was by writ of attaint; but this course is now justly exploded, and a new trial is granted upon application to the court from which the cause issued.

A new trial, in many cases, may be absolutely necessary. But it is not granted upon nice and formal objections, which do not go to the real merits; nor where the scales of evidence hang nearly equal. It is generally upon some misdirection by the judge to the jury, in point of law, or where a jury has found a verdict directly ag evidence; but where there has been dence as to the fact in doubt, on both the court will not interfere. It is granted where damages have been beyond the ordinary measure of jus and where the party has been surprise some evidence which he has subsequ the means of answering, but had not a trial. It is always refused where the mages do not exceed 10*l*.

NICANDRIA, *in botany*, so named Nicander of Colophon, a genus of the candria Monogynia class and order. E tial character: calyx turbinate, color four parted; corolla one-petalled, ten-c germ encircled with a membranaceous r stigma peltate, orbicular, six-rayed; b roundish, six-grooved, three-celled, m seeded. There is one species, viz. N. am a native of the large forest of Guiana.

END OF VOL. IV.

C. WHITTINGHAM, Printer,
103, Goswell Street.

MAMMALIA. Plate XV.

Fig. 1. Lemur catta Ring tailed Macauco.
2. ——— ecaudatus tailless Macauco.
3. Lepus cuniculus Domestic Rabbit.
4. ——— timidus Male & female Hare.
5. Manis pentadactyla short tailed Manis.

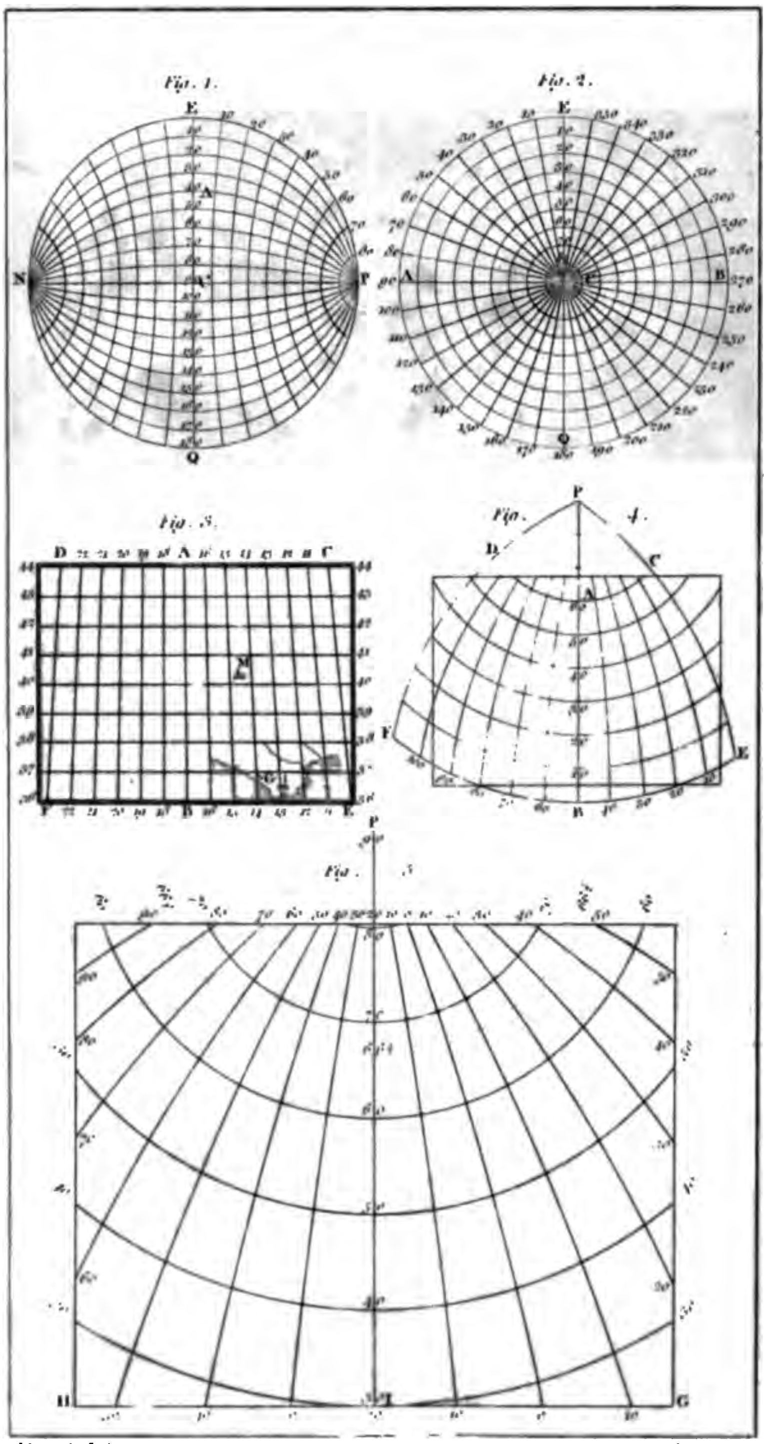
London Published by Longman, Hurst, Rees & Orme, Feb. 1, 1808.

Scott sc.

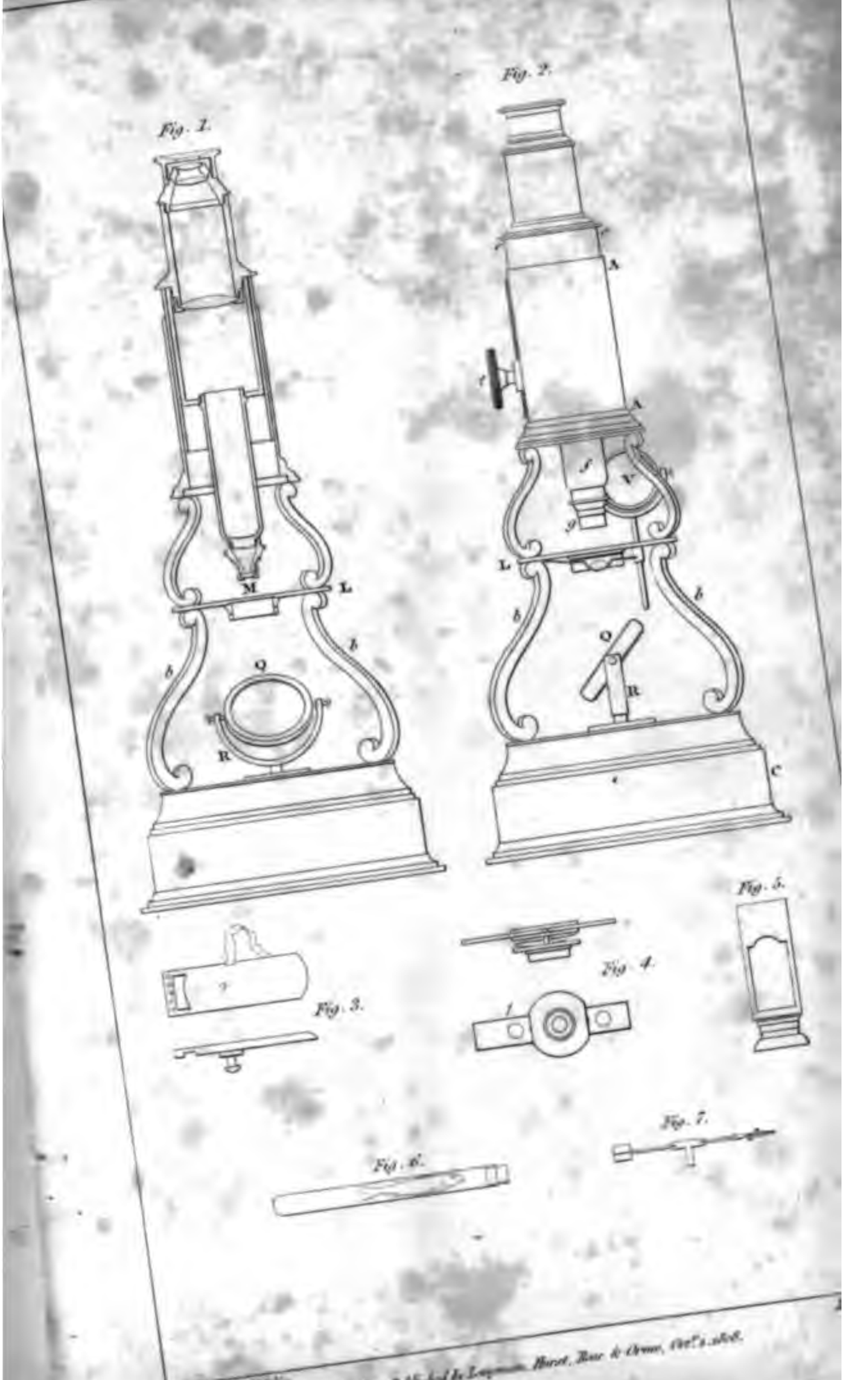
Fig. 1. Mus pumilio. Lineated Mouse.
2. —— striatus. Striated Mouse.
3. Mustella erminea. Stoat.
4. —— furo. Ferret.
5. —— Zibellina. Sable.
6. —— lutra. Otter.

London Published by Longman, Hurst, Rees & Orme. Feb [illegible]

MAPS.



COMPOUND MICROSCOPE.

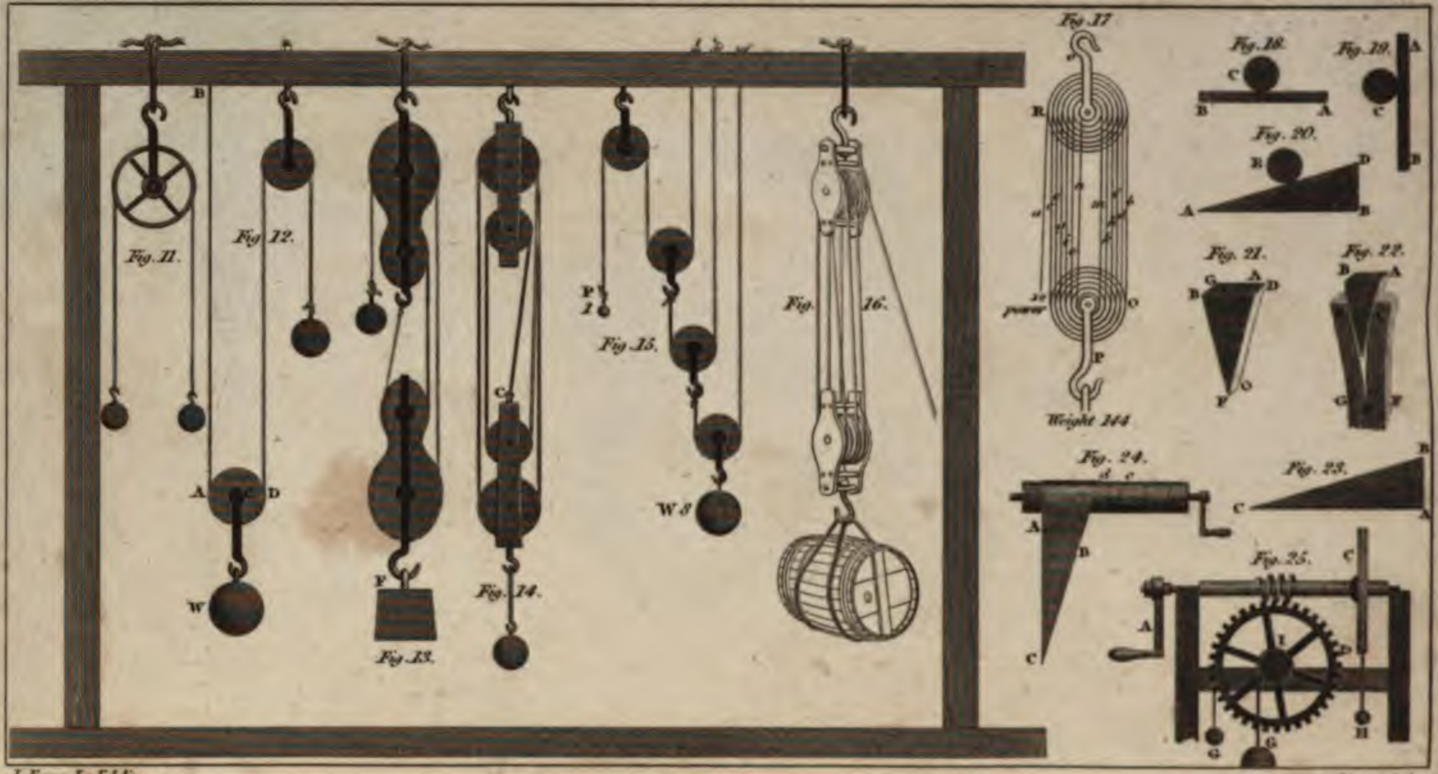


J. Farey Jun. delin.

London. Published by Longman, Hurst, Rees & Orme, Oct. 1 1808.

MECHANICS.

Plate II.



J. Farey Junr. delin.

Lowry sculp.

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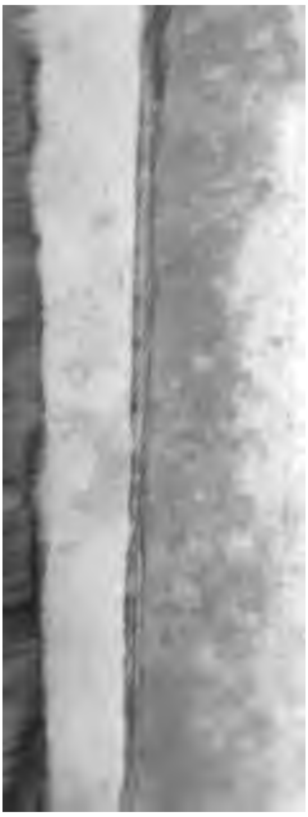
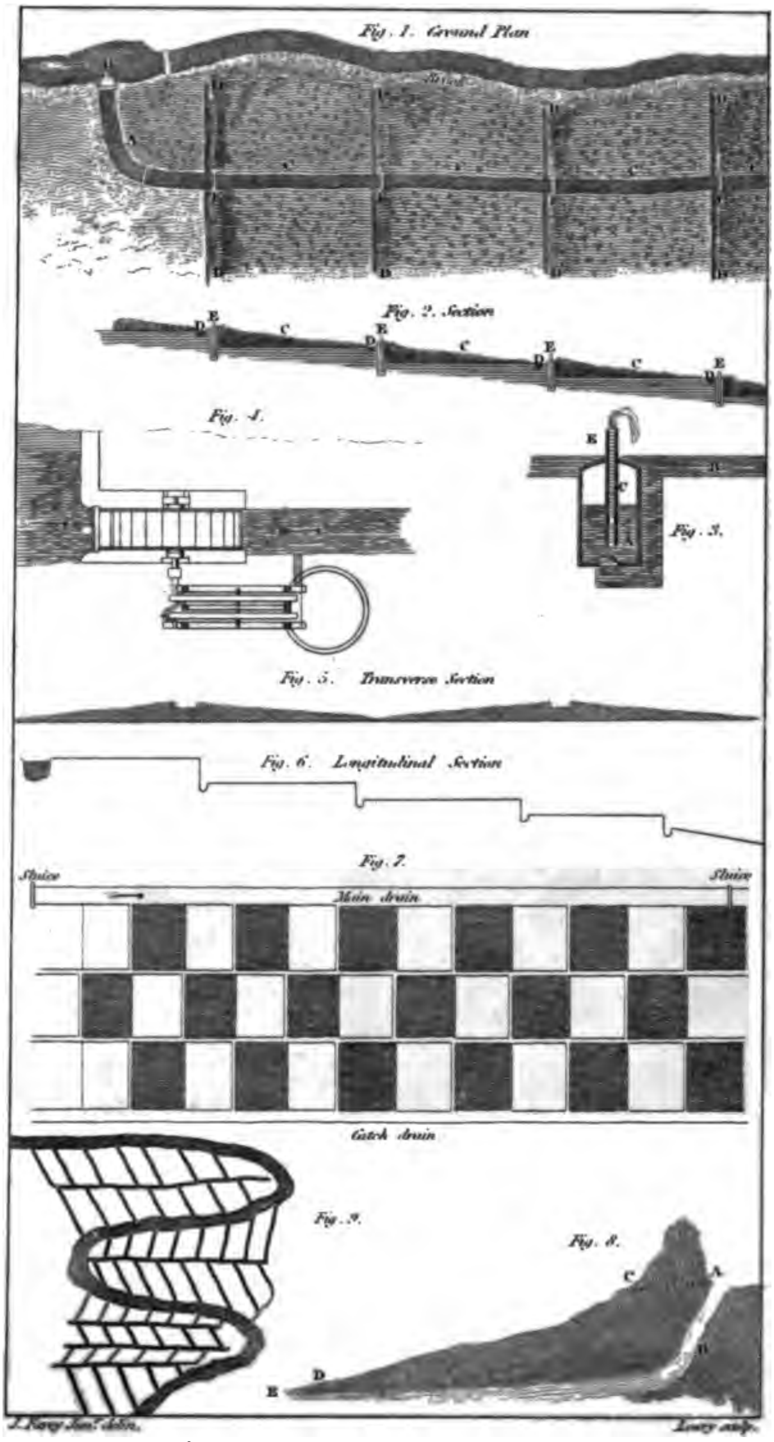


IRRIGATION.



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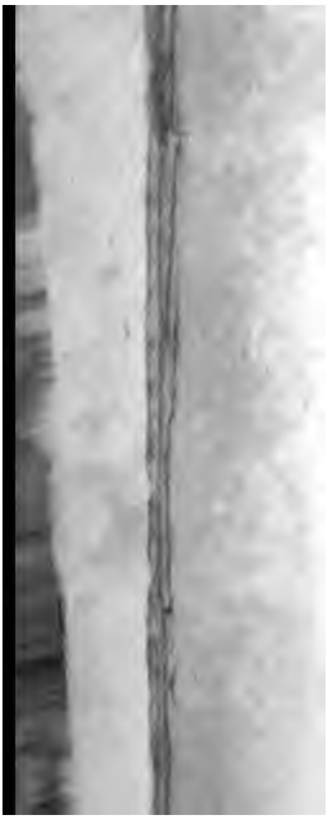
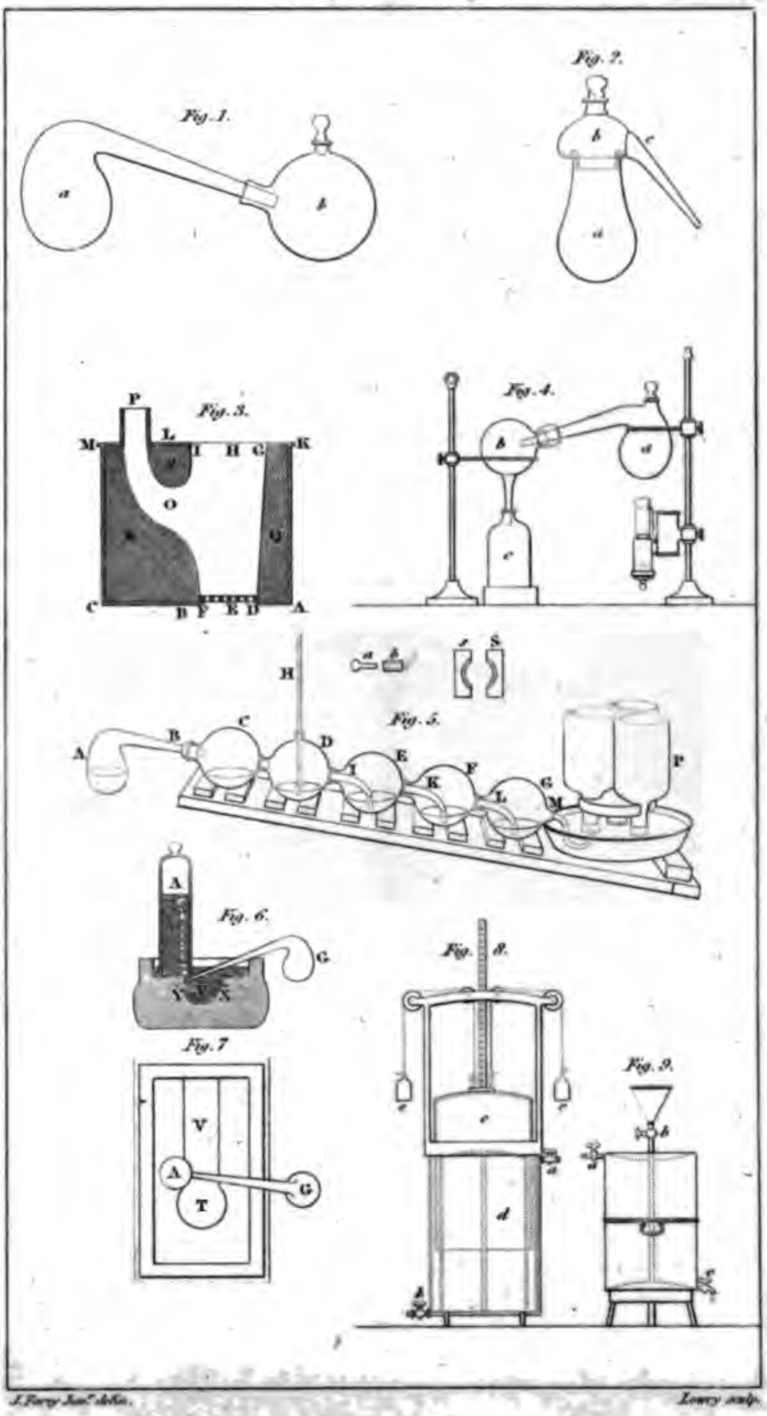


LABORATORY.



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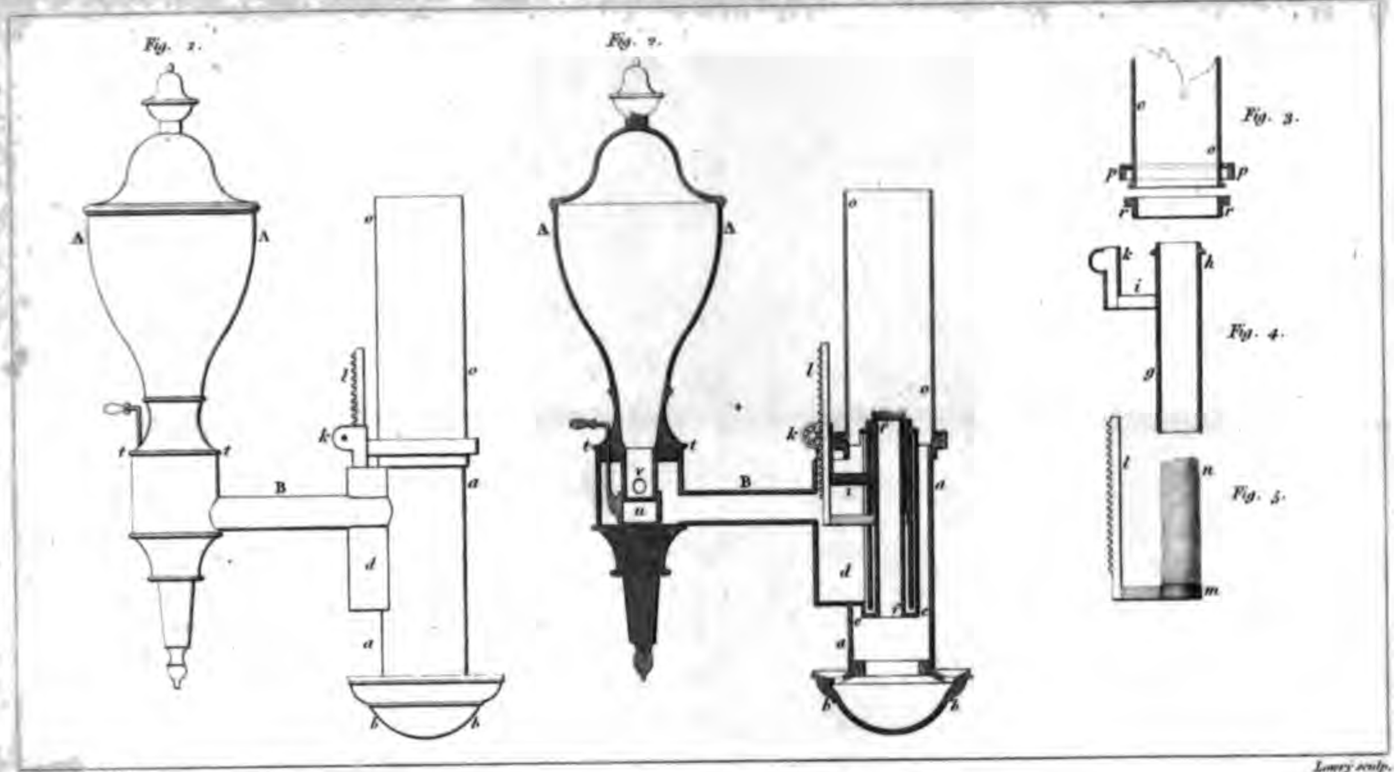
Argand Lamp.



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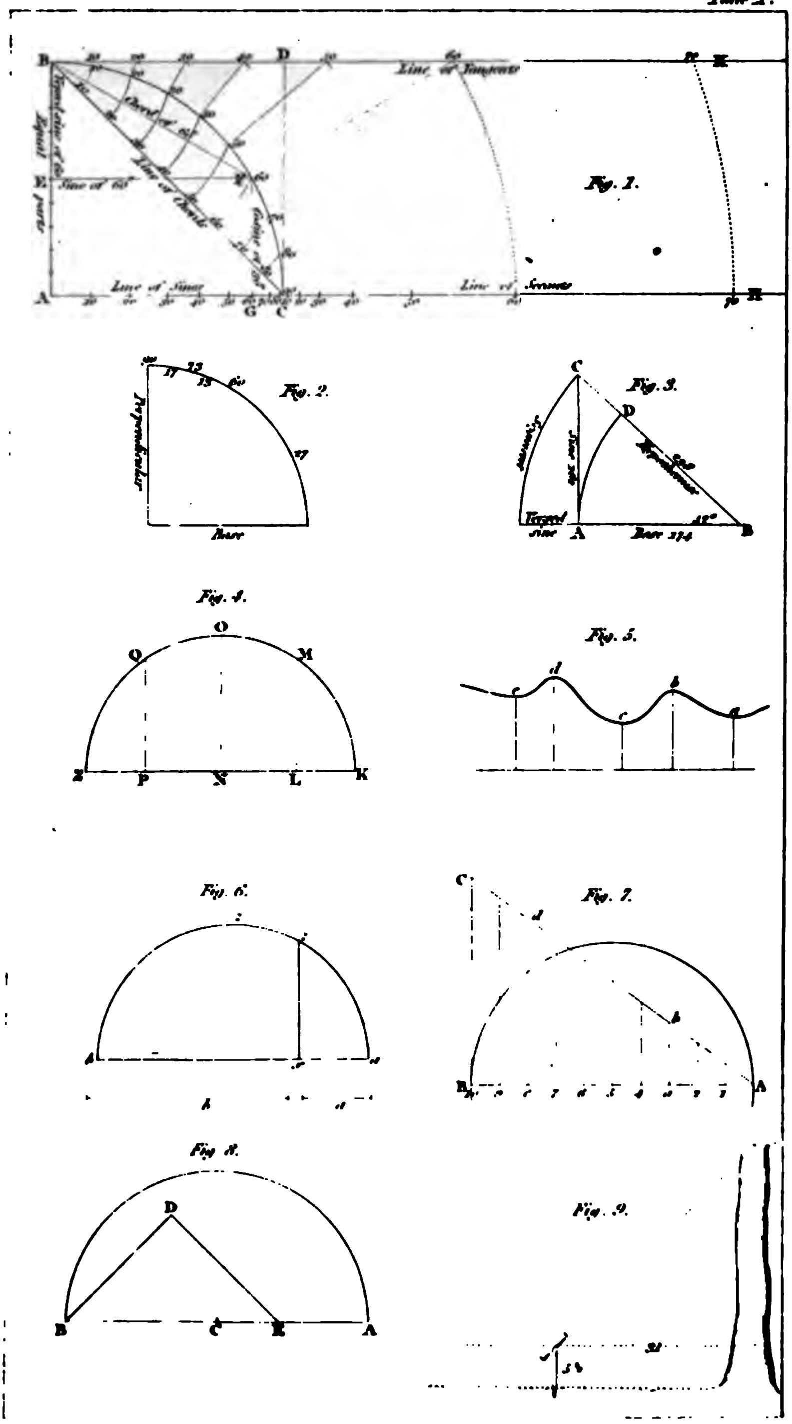

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SPIRIT LEVEL made by Ramsden.

Section *Fig. 1.*

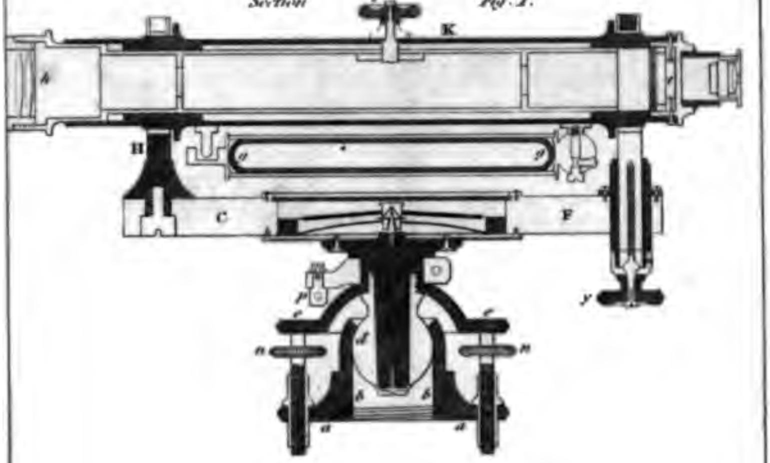
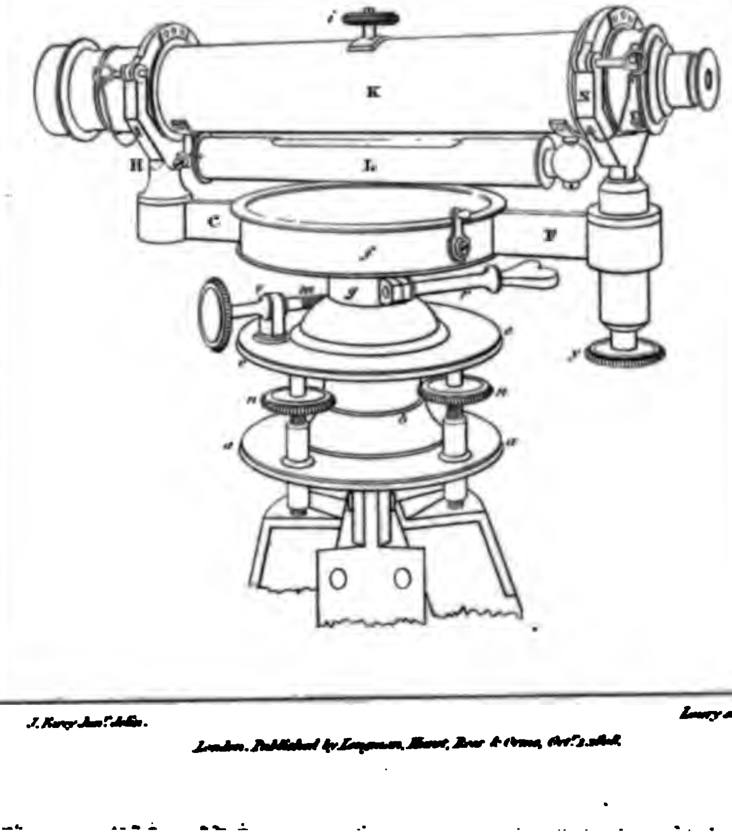


Fig. 2.



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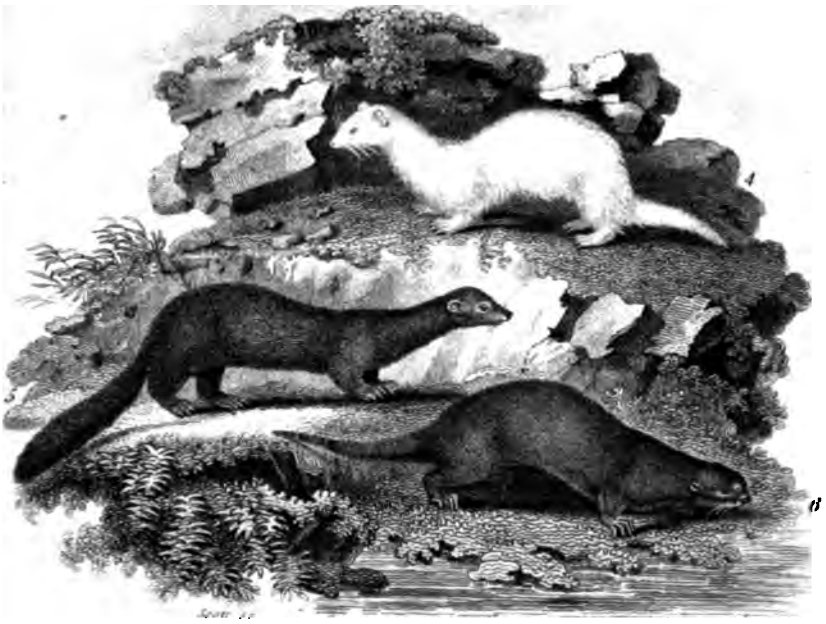

Fig 1 Mus pumilio Lineated Mouse
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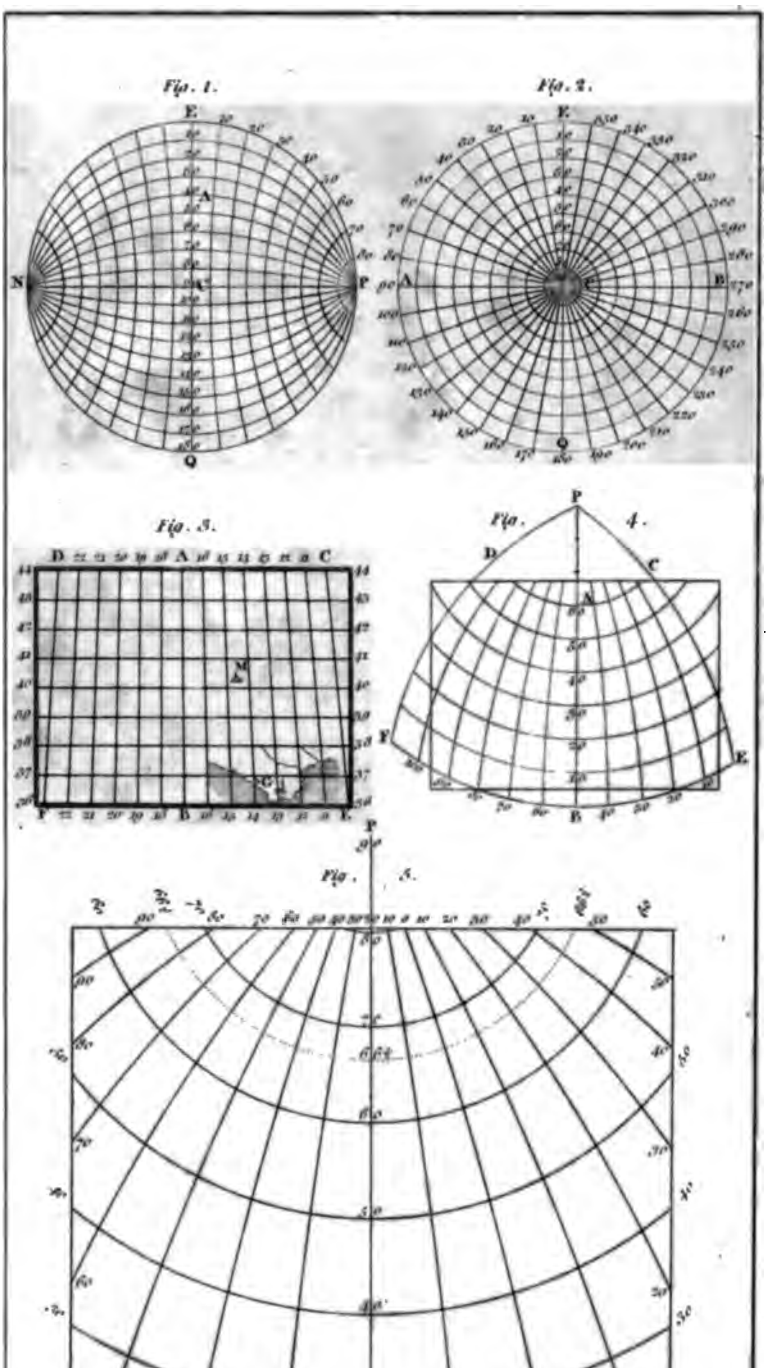

J. Farey Junr. delin.

Lowry sculp.

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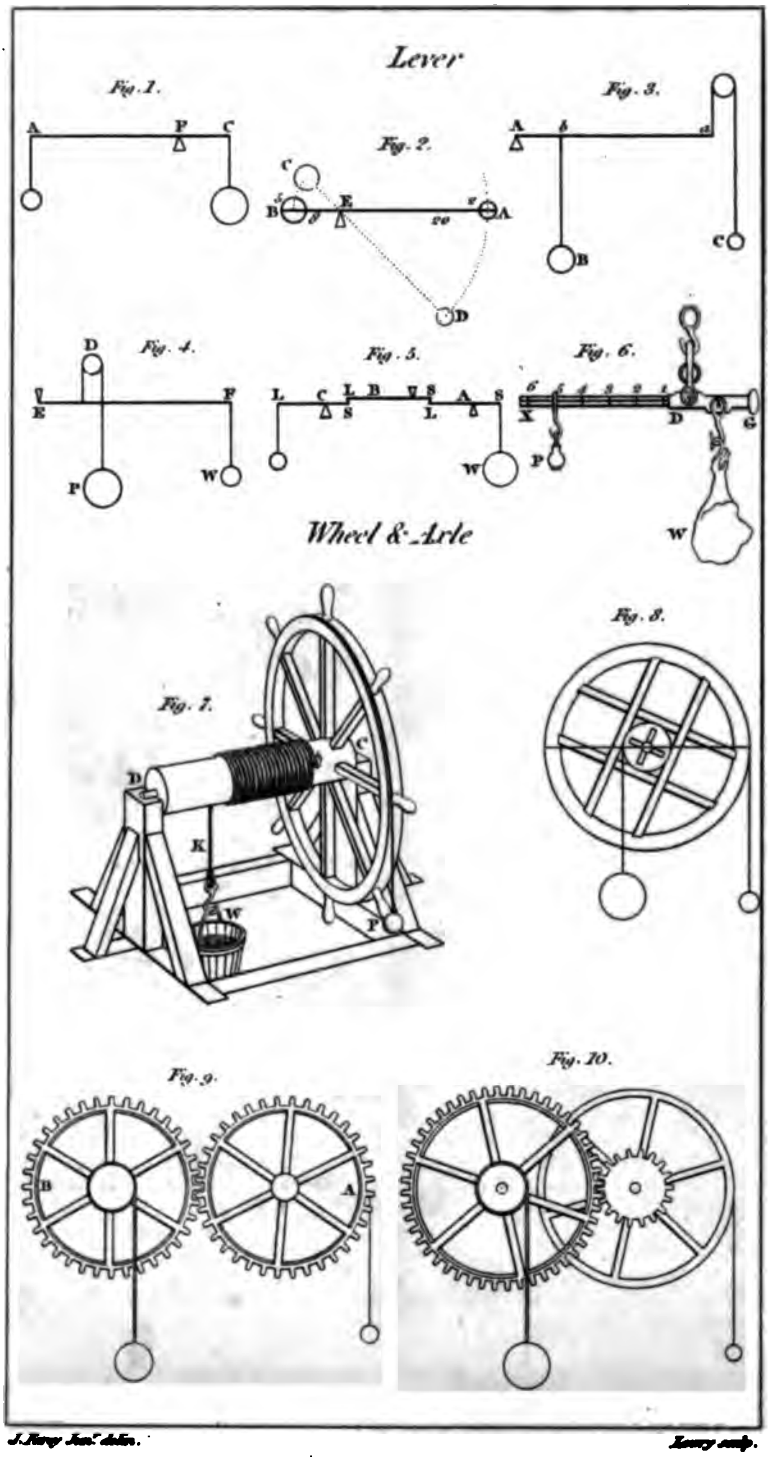

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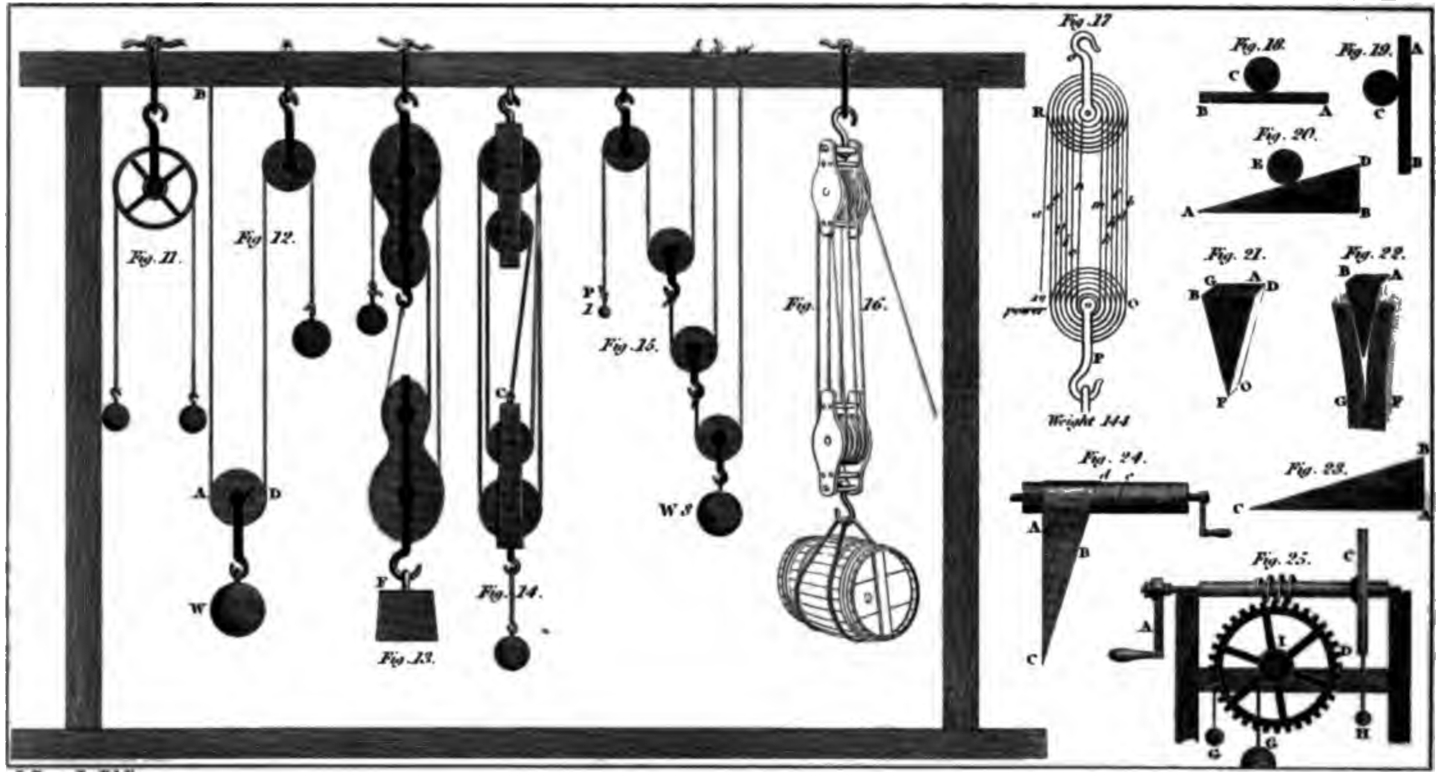
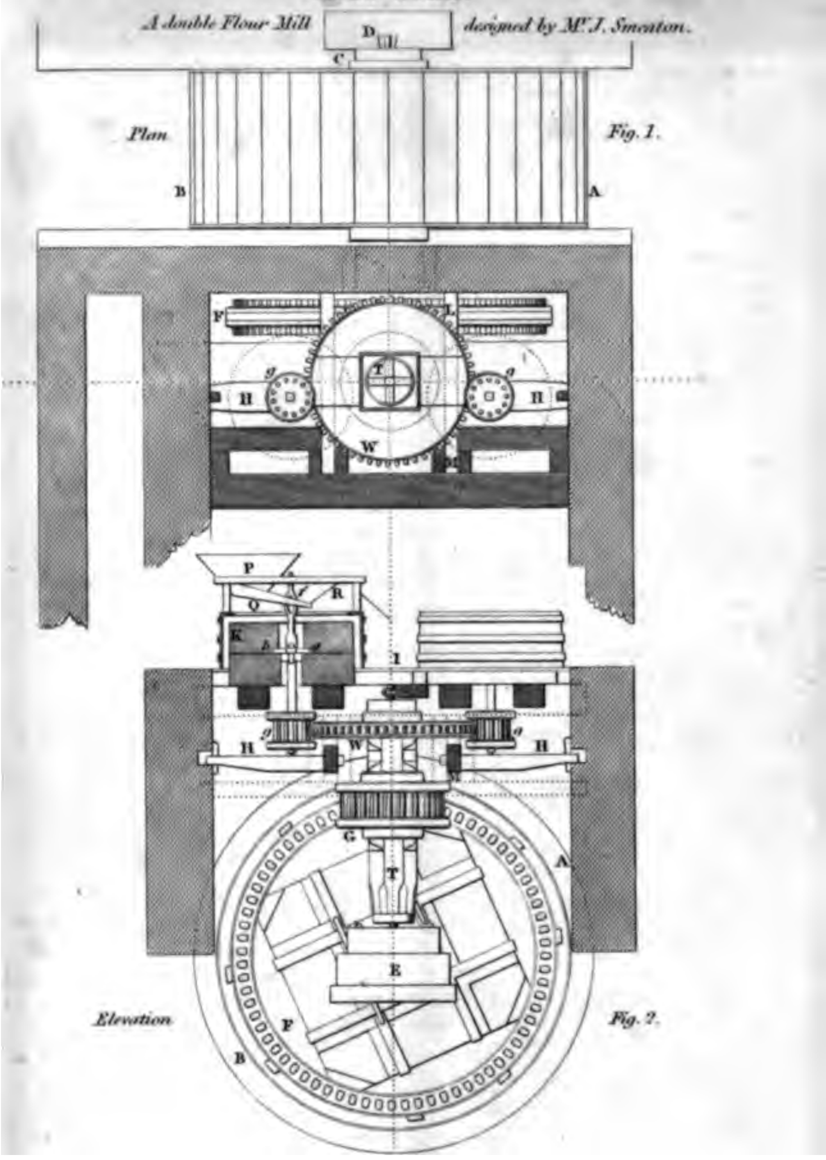
MECHANICS. Plate II.



J. Farey Junr. delin. Lowry sculp.

MILL WORK.

A double Flour Mill designed by Mr. J. Smeaton.



Plan Fig. 1.

Elevation Fig. 2.

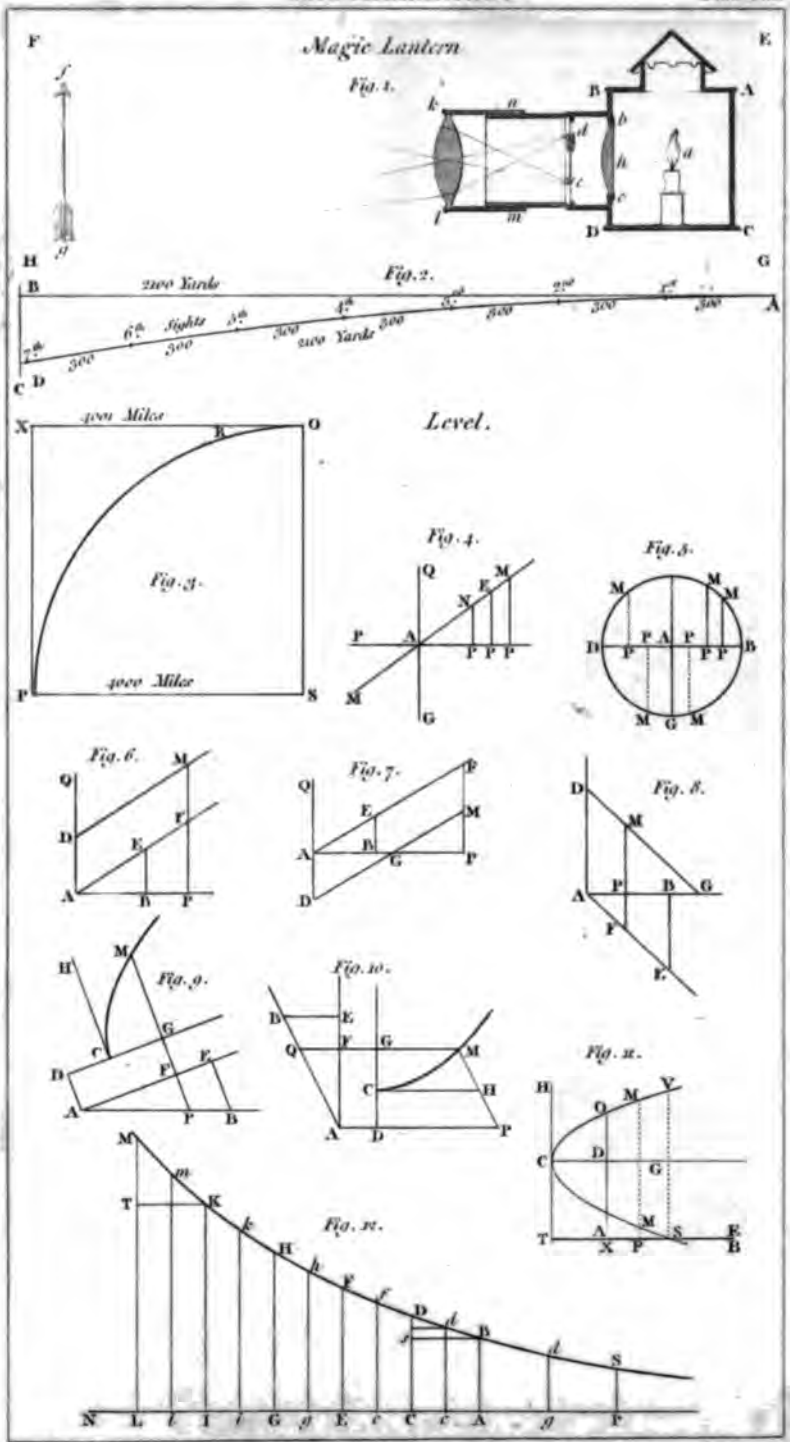
Scale of Feet.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Reduced from the Original drawing in the possession of Sir Joseph Banks, K.B. by J. Farey Junr.

Lowry sculp.

London. Published by Longman, Hurst, Rees & Orme, June 1st 1808.



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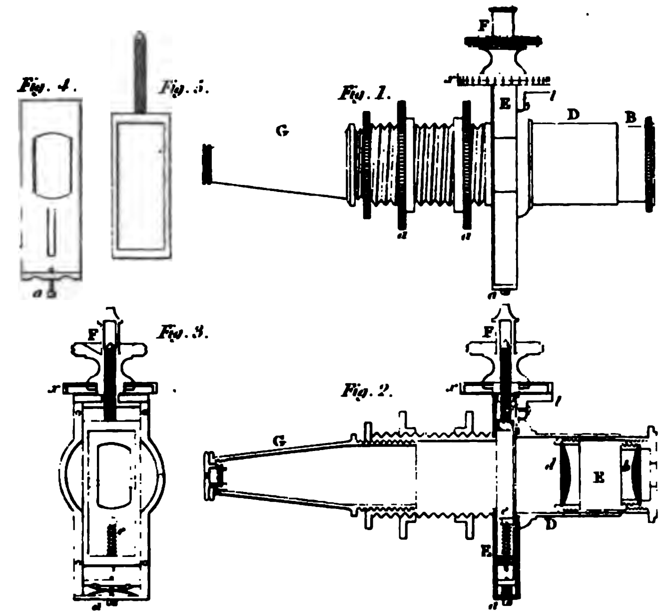
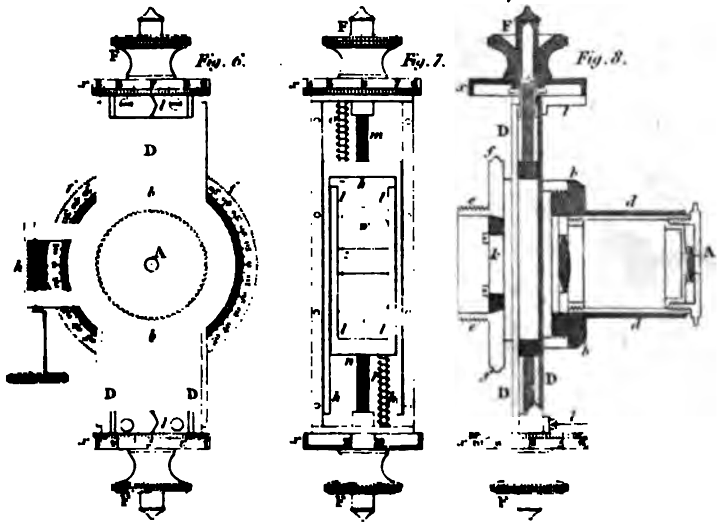
Microscope for observing the divisions on Mathematical Instruments, as made by Mr. Troughton.



Micrometer for the Eye Piece of a Telescope.



J Farey Junr. delin. Lowry sculp.

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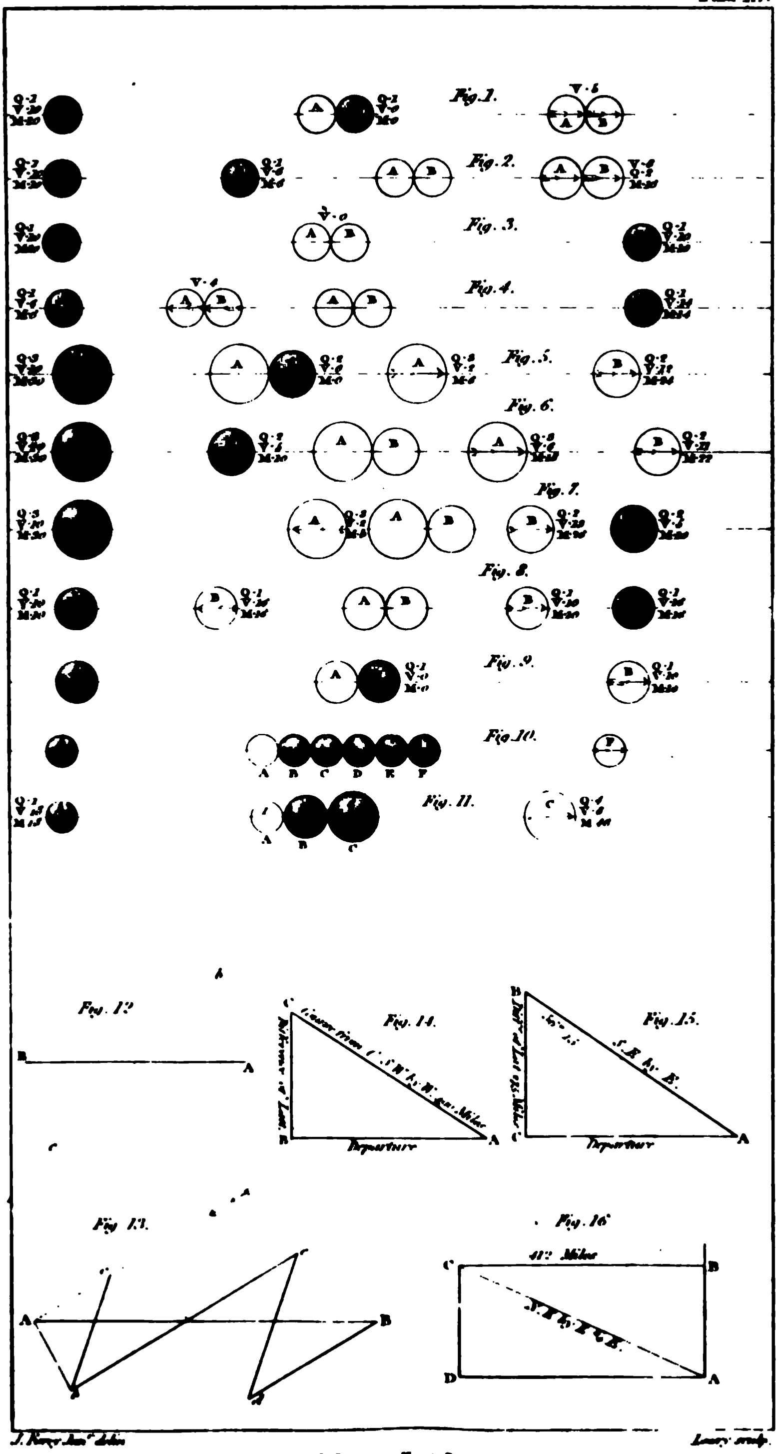

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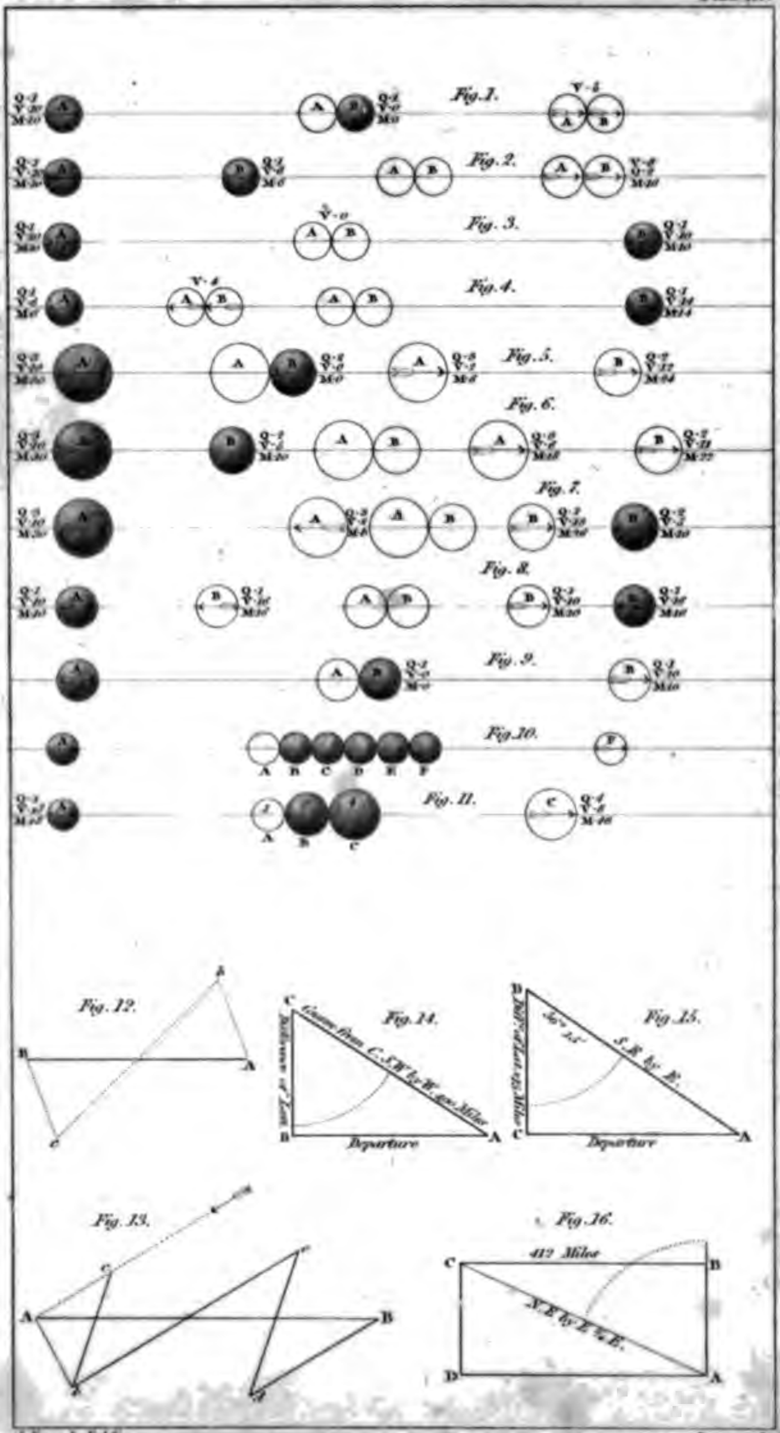

J. Farey Junr. delin. Lowry sculp.

Scott sc.

Fig. 1. **Kurtus** *Indicus : Indian Kurtus _ Fig. 2.* **Labrus** *[illegible] : Blue lined Labrus _ Fig. 3.* **Lophius** *[illegible] : Harlequin Angler _ Fig. 4.* **Loricaria** *costata : ribbed loricaria _ Fig. 5.* **Muraena** *catenata : chain striped Muraena :*

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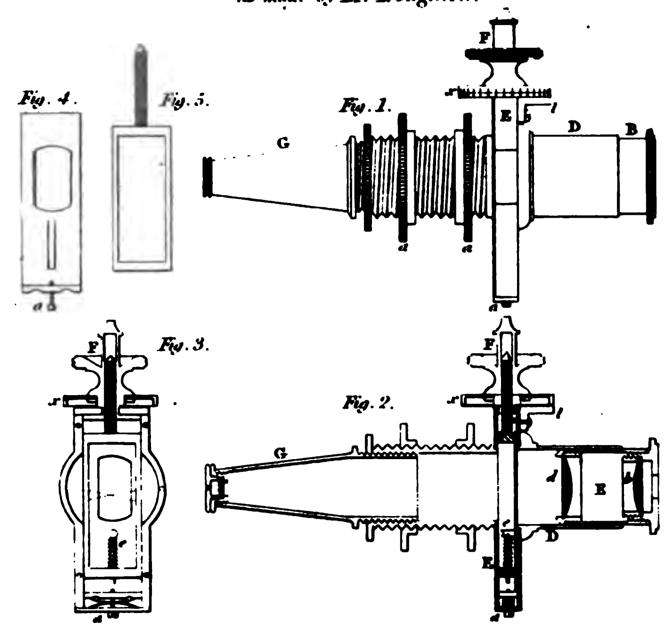
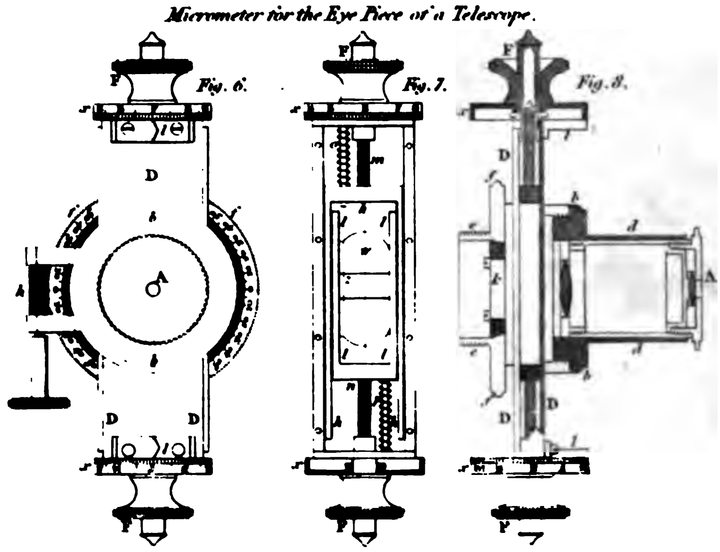
Microscope for observing the divisions on Mathematical Instruments,
as made by Mr. Troughton.



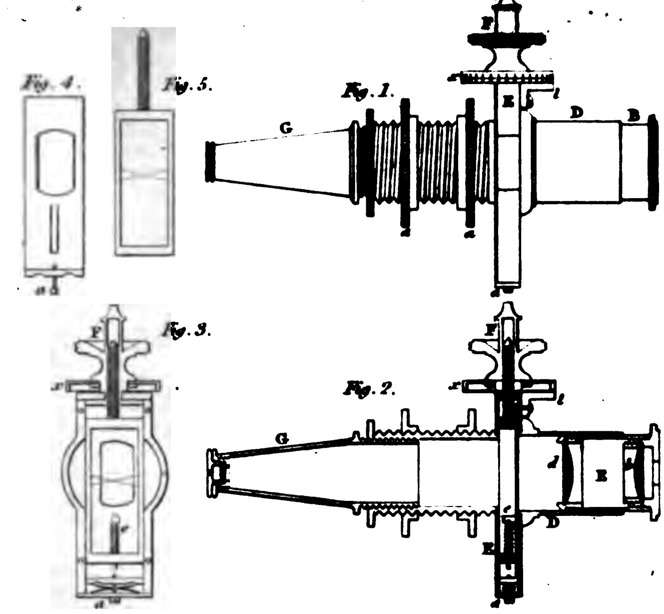
Micrometer for the Eye Piece of a Telescope.



J. Farey Junr. delin. Lowry sculp.

London. Published by Longman, Hurst, Rees & Orme, June 1st 18[illegible].

[illegible] Instruments, as made by Mr. Troughton.



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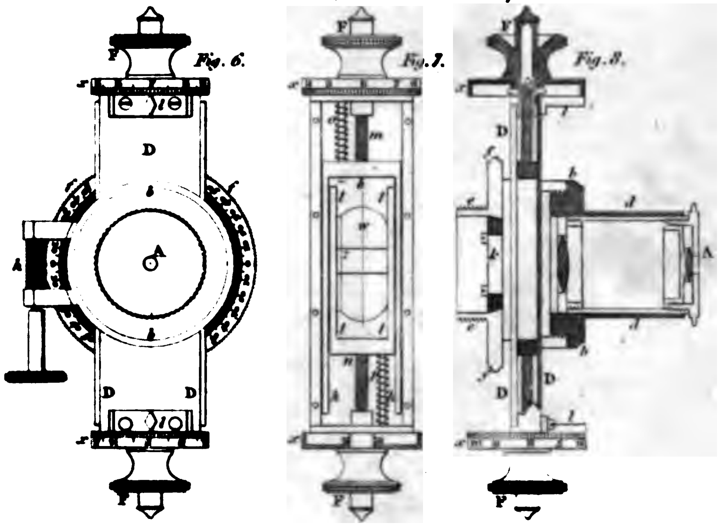

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